SCIENCE

MAY 26, 1950

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LAURA THOMPSON

SCIENTIFIC COORDINATION IN THE SOUTH PACIFIC
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TECHNICAL PAPERS

COMMENTS AND COMMUNICATIONS

SCIENTIFIC BOOK REGISTER

NEWS AND NOTES

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VOLUME 111, NUMBER 2891

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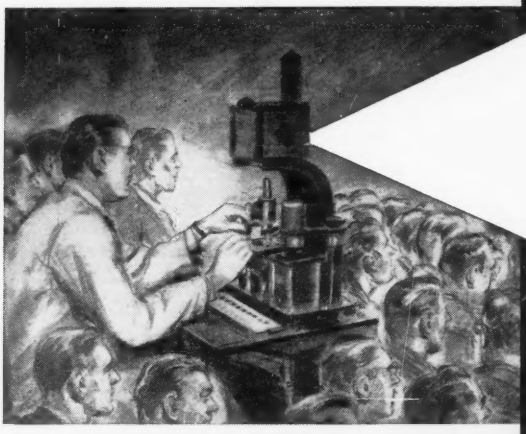

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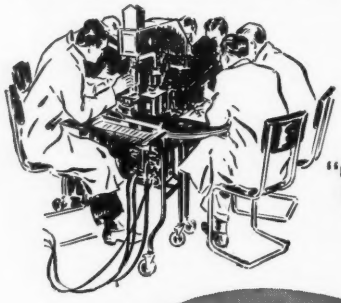

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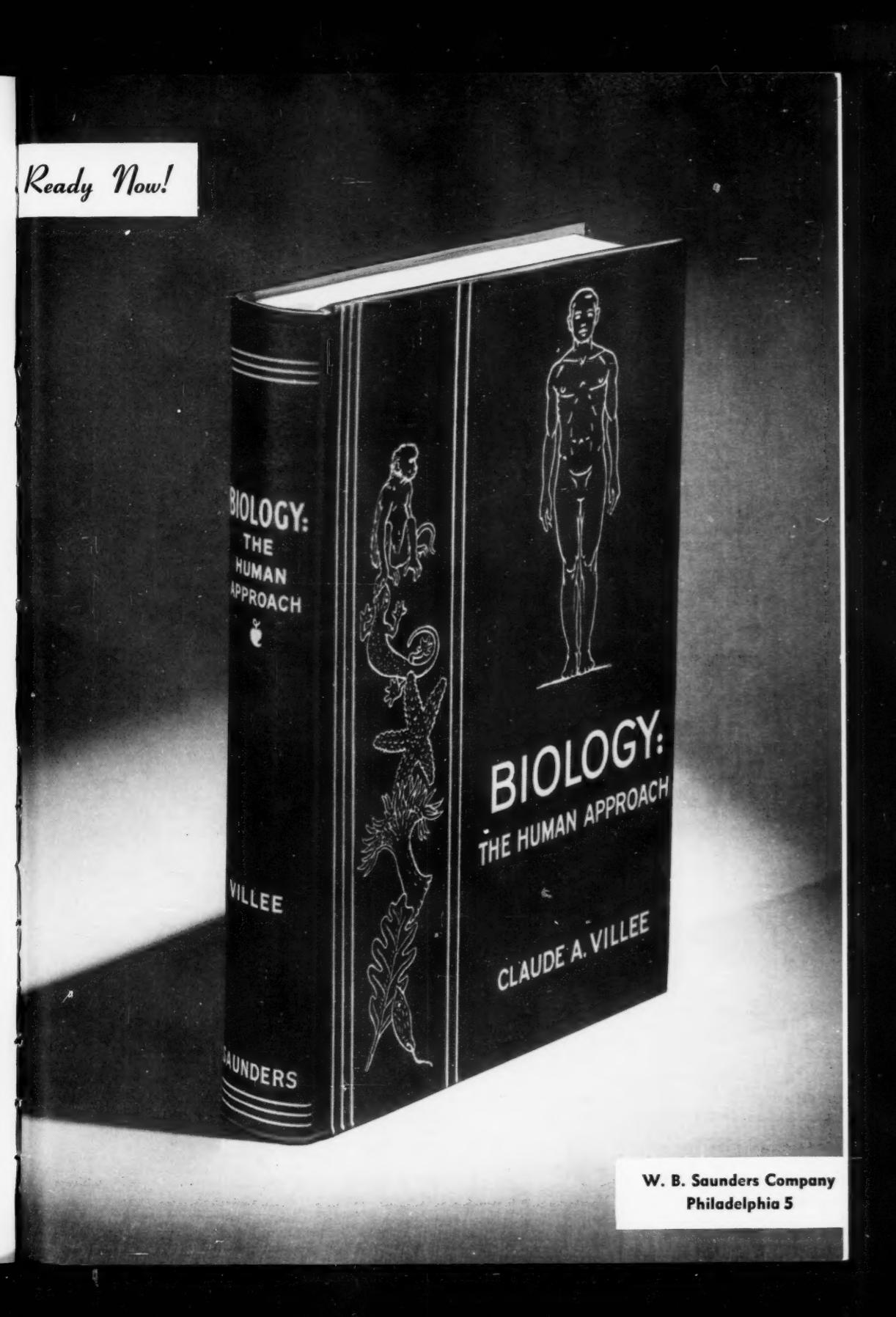
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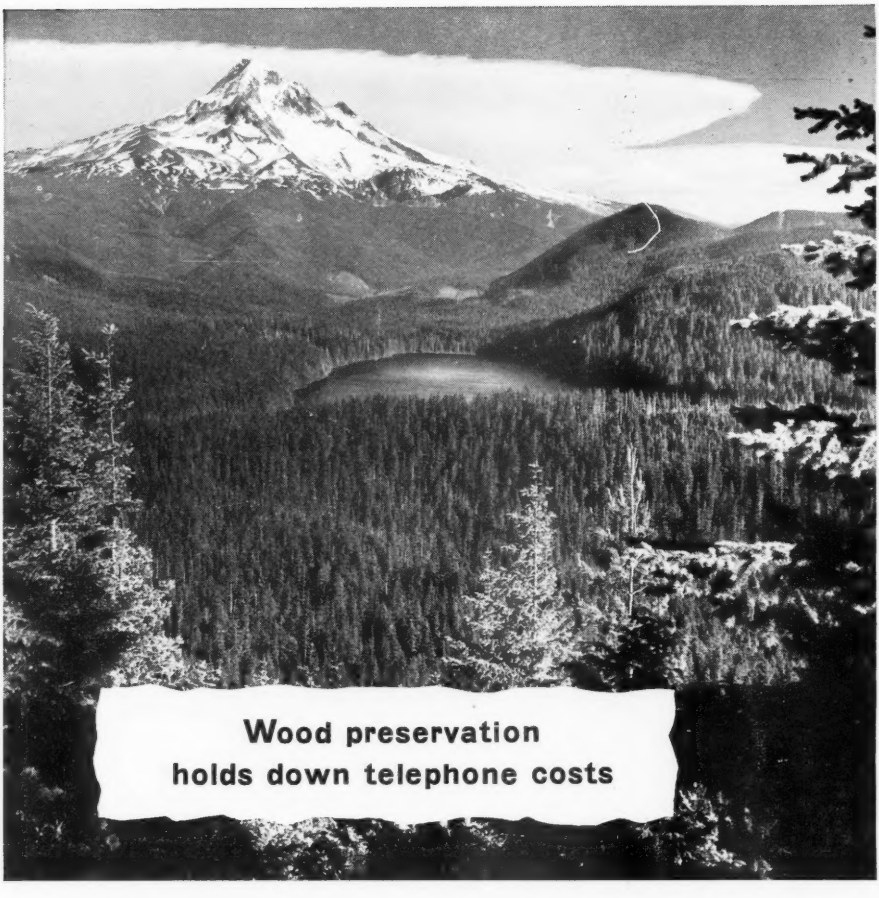

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Science, a weekly journal founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Editorial and Advertising Offices, 1515 Massachusetts Ave., N.W., Washington 5, D. C. Telephone, Executive 6060. Cable address, SCIMAG, Washington, D. C. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P.L. & R. of 1948.

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J. H. HOLLOMON

Research Laboratory

NUCLEATION: Such diverse problems as the kinetics of phase transformations, the formation of cracks in solids or of bubbles in liquids, and the formation of reversed domains during demagnetization have been treated in terms of the concepts of nucleation and growth. By nucleation is meant the formation of a new and distinct region separated from its surroundings by a discrete boundary. Nucleation is involved in the formation of a small droplet of water from water vapor, the formation of a small region of body-centered cubic iron within a face-centered cubic matrix, and the formation of a region of ferromagnetic material having one-spin orientation in a matrix in which the orientation of the spins is different.

The problem of nucleation, then, is pertinent to some of the most interesting transformations occurring in nature, and by control of the rate of nucleation the transformations can be controlled. Recently, for example, it has become possible to modify the weather over large geographic regions by simply inducing the nucleation of ice from a cloud of water droplets. Recently also metals have been significantly supercooled by preventing the formation of nuclei over a wide range of temperatures.

American Society of Metals, Cleveland, October 15, 1949

★

K. H. KINGDON

Knolls Atomic Power Laboratory

ATOMIC-ENERGY TRAINING: About 60,000 people are now engaged in the new and potentially large field of atomic-energy work. At present these people are employed directly by the Atomic Energy Commission and its contractors. If the production of power from atomic energy becomes an economic reality, such production will doubtless be participated in by private industry and will demand additional technical people.

Most of the technical people to be used in the atomic-power effort in the future will need training in special fields of current engineering, and in physical, chemical, and metallurgical skills. Perhaps ten percent will need the new fission and neutron knowledge of modern nuclear physics. Some of this they will be able to get in universities, but security restrictions and the probably continued general unavailability of nuclear reactors and other expensive and restricted equipment and materials will mean that much of the specialized technical knowledge will have to be obtained on the job.

A considerably larger group than the ten percent mentioned, and consisting of chemists, chemical engineers, and health physicists, will need practical knowledge of how to handle radioactive materials in bulk. Here, again, this knowledge will probably have to be obtained on the job.

General Electric Review, February, 1950.

★

A. D. MARSHALL

Assistant Secretary

COMPULSORY RETIREMENT: It seems to me that a sound pension plan should prepare a man for retirement in several ways, not just provide a depreciation reserve to take care of him when his usefulness is ended.

There must be financial preparation. His employer's program can be expected to provide him with retirement income bearing some reasonable relationship to his earnings during his working life. He should be encouraged to systematically save to provide for the good things of life after retirement. But financial preparation, even if it is more than adequate judged by our present high standards, is not the only preparation necessary for retirement.

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Industrial Relations Conference, Detroit, Mich., January 24, 1950.

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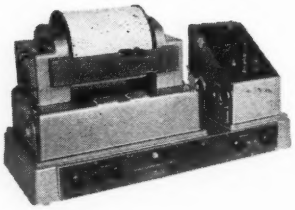

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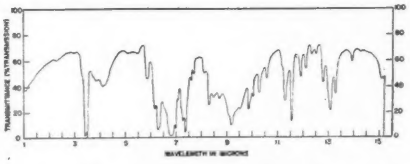

This is the Nujol mull spectrum of Schering Corporation's antihistamine, Chlor-Trimeton Maleate (brand name of chlorprophenpyridamine maleate). It was recorded on a Perkin-Elmer Model 21 Infrared Spectrophotometer in 8 minutes.

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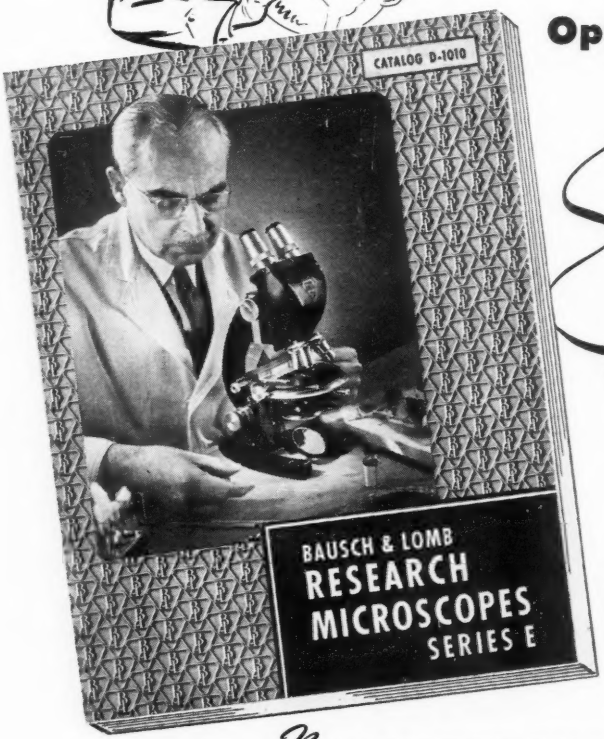

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Science and the Study of Mankind[1]

Laura Thompson

Institute of Ethnic Affairs, Washington, D. C.

THE REVOLUTION that has been taking place in science in the last century is apparently changing our conception of reality and the function of science regarding it. Indeed it seems to be overthrowing what we regard ordinarily as plain common sense: namely, the view of reality that is deeply embedded in, and perpetuated by, the peculiarities of Western European languages.

As is well known, our bias is related to the subject-predicate bifurcation of our sentence structure, which makes it impossible for us to formulate a sentence without a substantive either stated or implied, and which compels us to separate noun from verb, actor from action, form from function, etc. This linguistic peculiarity helps to condition us to the twofold slicing of experience so characteristic of Western civilization: i.e., our traditional division of "matter" from "mind," and our notion of matter as in itself inert and acted on only *externally* by forces. These and other grammatical forms characteristic of Western European languages are now recognized as having played an important role in structuring our world view, which we generally accept as simple common sense (*4*; *13*, p. 53; *15*; *16*).

On the other hand, fundamental to the revolution in modern science seem to be the following basic assumptions (*4*, p. 63; *10*; *13*, p. 90; *17*): 1. The external world is real and exists quite apart from any esthetic intuitions or logical assumptions on the part of man. 2. The external world is ordered and bound by immanent formative process or law according to which all of nature is interrelated and each event is an outgrowth of past events and a forerunner of future events. 3. The primary aim of scientific inquiry is not to understand what, ontologically speaking, these events are—since the nature of ultimate reality is beyond our reach as scientists—but rather to discover their inner dynamic relationships or structure.

All the sciences are gradually undergoing this revolution; but the social sciences, owing partly to their dependence on language as a basic means of expression and communication, are the last to be drawn into the great transformation. Since this lag in the development of the social sciences seems to be a crucial factor holding up the resolution of the current world crisis, it is important that social scientists concern themselves with it.

Actually, when we attempt to extend the new view of science to the study of mankind, it follows logically that man, as an integral part of nature, is a component in the dynamic natural order just postulated, and that the sciences of man are natural sciences. Furthermore, the ultimate aim of the scientist of mankind is recognized as that of attempting to understand man as part of the inherently lawful, dynamic natural order, that is, to understand man in his interrelationship with the world of nature, including other men. The significant units of research in the human sciences become human events viewed as complex wholes in space and time; they become nature-culture-personality events and occasions in space and time. The meaningful type of problem concerning these units becomes the investigation of their dynamic structures, that is to say, their inner relationships in full environmental context. Logically, the solution of such types of problems requires the cooperative, integral efforts of the major sciences of man with the help of other basic sciences.

We may infer, furthermore, that by increasing our knowledge of the inner dynamic structure of a nature-culture-personality whole, we shall also increase our ability scientifically to predict future events to the extent that they are predictable; namely, to the extent that they are manifest within and determined by the structural whole (*7*, p. 59; *13*, pp. 90–91; *14*, p. 250). Finally, following through this hypothesis, it seems probable that, once we begin to describe nature-culture-personality wholes from the viewpoint of their inner dynamic structures, we shall be able to compare them and to establish scientifically valid similarities and differences in basic structures between them.

From these general considerations let us turn to a specific research project which has attempted to test the hypothesis. The Hopi Indians are one of five tribes[2] studied as part of the Indian Personality and Administration Research, sponsored jointly by the U. S. Office of Indian Affairs, the University of Chicago's Committee on Human Development, and the Society for Applied Anthropology. The Hopi group consists of some four thousand Indians who,

[1] Based on a chapter from the writer's book *Culture in Crisis: A Study of the Hopi Indians*, to be published by Harper and Bros. this fall.

[2] The Navaho, Papago, Sioux, and Zuni tribes were also investigated as part of the project. For a list of project publications see reference 8. The writer was coordinator of the project from its inception in 1941 to its termination in 1947.

for more than fifteen centuries, have inhabited a few square miles of desert and semidesert highland in northern Arizona. A representative sample of two Hopi communities, expressing differing kinds and degrees of Euro-American influences, was investigated in total environmental setting and in historical perspective. Techniques from many sciences, including ecology, cultural anthropology, sociology, psychology, psychiatry, clinical medicine, and linguistics, were used integratively. From this broad-gauged, relatively precise analysis of the complex Hopi event in space and time have emerged facts and generalizations of theoretical and practical moment.[3]

Analysis of the Hopi nature-culture-personality integrate suggests that for at least fifteen centuries the Hopi tribe has played its life drama dependent on a relatively limited and isolated geographic area of such a nature as to allow a narrow range of choice regarding the group's adjustment to it. The arid northern Arizona plateau posed unyielding imperatives which had to be met habitually and unerringly if the tribe were to survive and reproduce itself generation after generation. Specifically, the existence of this group of sedentary agriculturists in Hopiland has always been linked with the regional water supply. The tribe's survival has depended on the presence of a few semipermanent springs used for drinking water and garden irrigation, on the retention of moisture in sand dunes used for dry farming, and on the fanning out of water at time of flood in such a way as to allow arroyo flood farming. Agriculture in Hopiland has always been limited and hazardous because of low rainfall and humidity, frequent droughts, floods, and storms, killing frosts, and pests. Although these Indians supplemented their farming by hunting in the vicinity of their mesas, subsistence was an ever present problem. No matter how industriously they stored up food to tide over their frequent crop failures, drought occasionally outlasted the food supply. Theirs was indeed an economy of scarcity. Thus the Hopi had constantly to cope with the problem of actual group survival and, although they solved this problem, it is likely that their precarious existence tended to take a physical toll in undernutrition, illness, and premature death, especially among the children.

Faced with these constant and intense environmental pressures, the Hopi through the centuries developed a social system which was apparently well adjusted to their indigenous needs. In brief, Hopi traditional society expresses a complementary relationship, a mutual dependence between a female-centered kinship system and a male-centered secret society system, integrated through an annual ceremonial cycle. The relationship between the kinship and secret society systems gives a fine balance to Hopi social organization and tends to equilibrate the status of men and women in Hopi society. Each sex has its unique and indispensable place, role, and function. The complementary biological functions of male and female are institutionalized in a complex, correlatively balanced social order. The system has been extended by means of totemic devices to include all classes of phenomena important to the Hopi lifeway, so that it functions as a sort of cooperative supersociety embracing man and the world of nature. All phenomena of value in the Hopi world are traditionally believed to work together in a complex, interdependent relationship, for the common good, and no one class is dominant or subordinate to the others. The concepts of "rugged individualism" and "exploitation" are completely absent, for no individual functions for himself alone, but only as a member of a group that is a responsible part of the complex, reciprocally balanced whole.

In a traditionally organized Hopi pueblo every individual is expected to fulfill his obligations to the group with a minimum of supervision and with a minimum of external controls exercised by centralized authority or by physical force. Characteristically, social controls are diffused and internalized. They tend to extend inward in the form of a group-structured individual conscience which reflects the group's ethical code, and also they tend to extend outward to the farthest reaches of the Hopi natural and supernatural world. Traditional leadership is self-effacing, obligatory, and socially responsible. Indeed, exposed as the Hopi have been through the centuries to all the hazards of the external environment, including out-group attacks, they have developed a social system which apparently allows and encourages the development of their human potential to a high level of efficiency and a high degree of intensity.

We do not know how great a psychological toll in anxiety and frustration was exacted in ancient times by all these pressures. But the personality findings from children of the First Mesa community, where the ancient social structure persists virtually intact, suggest that the balanced social system of the Hopi was reflected in a characteristically balanced and healthy personality structure, distinguished by its subtle complexity within definite boundaries; by its social, emotional, and artistic maturity within allowed areas; by its many-sided and deep-rooted control system; by its high puzzle-solving type of intelligence; and by its abstract, holistic, and at the same time practical, type of mental approach.

[3] Detailed documentation of the findings and generalizations from the Hopi project are presented in references *10* and *11*.

While the Hopi's basic-discipline training is definitely permissive and Hopi babies are characteristically happy and smiling, indigenous patterns of inducting the child into the social group, although nicely adjusted to the Hopi developmental curve, are relatively more systematic and concentrated and also more ritualized, than those of the other tribes studied in the Indian Personality and Administration Research, and relatively sterner methods are likely to be used when a child fails to meet social and moral expectations within the prescribed age range. Apparently these training patterns, in the context of Hopi social and cultural environment—which is both complicated and integrated in a balanced manner—tend to stimulate the child to a personality development that is somewhat precocious but at the same time emotionally balanced and socially mature, and of the kind needed to cope with Hopi life problems.

Finally, the findings suggest that the Hopi symbol system, expressed in language, mythology, ritual, and art, reflects a complex, subtly balanced, organic type of world view (*2*; *6*). While the world is believed to be very dangerous, it is not unpredictable or erratic, nor is man at the mercy of unpredictable or erratic forces. On the contrary, the universe is seen as a complex correlative system, controlled and regulated by natural law. There is no vagueness or inconsistency about man's role in this system, nor is it a subordinate or dependent one. And not only the character traits, but also the degree of intensity of emotional and mental energy needed to fulfill his role, are explicitly formulated and stressed. Indeed, the intensity of the Hopi's emotional and social atmosphere, as compared to that of the other tribes studied in the Indian Personality and Administration Project, seems directly to reflect the severity of environmental pressures and tensions that the tribe habitually sustains.

Thus, when the Hopi nature-culture-personality whole is analyzed as a multidimensional pattern of events in space and time, it reveals not only a high degree of integration, but also a delicately balanced, self-regulating type of structure.

Now I wish especially to point out that the type of structure described here appears to be similar to that which distinguishes ecologically balanced natural communities. Ecology teaches us that natural plant and animal communities tend in the course of time to move toward a delicately balanced, self-regulatory ecological arrangement in environmental context (*5*). In an ecologically balanced community the group supports the individual and the individual has to perform his particular function in the group. Characteristically, every individual has a place, a role, and a function in the whole arrangement, and this place, role, and function usually involve a certain unequivocal responsibility to the whole. The individual is an indispensable part of the whole and is of vital importance to it. Moreover, the values of functions and roles are not weighted. The balance of the parts and the whole is self-adjusting and self-regulating—in other words, it is organic. Furthermore, by a process of symbiosis, accommodation, and competition, isolated plant and animal communities in the course of time tend to move toward an optimum or climax type of organization, in which characteristically every niche tends to be used to full advantage and every individual tends to function with minimum waste of energy or potential energy. The Hopi analysis suggests that, like isolated plant and animal communities, isolated human communities under certain conditions tend to develop in the course of time toward an ecologically balanced optimum or near-climax type within the total environment.

On the other hand, the analysis suggests that whereas optimum or near-climax types of plant and animal communities are characterized by a high degree of organic integration in the context of the total environment, such types of *human* communities are integrated, not only organically and functionally, but also symbolically. In other words, the whole tends to be integrated not only in the manner of natural communities but also in a distinctively *human* manner; that is, esthetically and logically (*1*, pp. 24–25; *6*).

An intensive study of the covert aspects of the Hopi culture, and especially an analysis of the Hopi language from the conceptual point of view and its interrelation with the world view, ritual, art, myth, social organization, and group personality structure, led to the inference that the whole had an inner coherence which was logical as well as esthetic. And this logico-esthetic integrating dynamic seemed to give to the culture configuration its unique and persistent style [reference 7, p. 61].

Analysis of the Hopi nature-culture-personality integrate also reveals that the tribe is in the grip of a severe crisis of considerable historical depth and scope (*10*). This disturbance may be traced from its origin in the tribe's first contacts with the Spaniards in the 16th century through the period of Franciscan missions, Spanish wars, and Navaho raids, to more recent influences, especially those expressed in Protestant mission teachings, traditional Indian Service policies, and new federal policies. The analysis indicates that Mennonite mission influences tend to have a disintegrating effect on the Hopi socioreligious system, reflected in a disorganizing trend in male personality structure (*12*); that the traditional Indian Bureau policy in Hopiland has had a negative effect on Hopi welfare, modified somewhat by the inaccessibility and cultural resistance of the tribe; that al-

though federal policy and program have been changed officially, many individuals in Hopiland (both Indian and non-Indian) still express, in feeling, thought and behavior patterns, ideologies, and rationalizations similar to those underlying the traditional policy; and finally, that the new, integrative Indian Service policy, based on a positive philosophy regarding the creative nature of man and of society in environmental context, has had a markedly beneficial effect on the personal and social welfare of the tribe. The analysis also indicates, however, that, in Washington, and in the general American population, there is considerable misunderstanding of, and resistance to, the new federal policy and program in Hopiland.

The findings suggest that, although the Hopi crisis has a tribe-wide spread in its ecologic and biologic dimensions, it has reached acute proportions in its sociologic psychologic, and symbolic dimensions only in communities where the traditional ceremonial and social system has broken down under white pressures. The findings viewed as a whole lead to the conclusion that the core of the crisis is ideological.

These findings and generalizations also suggest that in ancient near-climax types of human communities like those of the traditional Hopi, wherein an ecologically balanced and self-regulatory type of structure and a high degree of organic and logico-esthetic integration with the total indigenous environment have developed, new cultural elements and patterns may be added and many of the accoutrements (or much of the so-called "content") of the culture may change or even disappear, but under favorable circumstances the ancient culture structure will endure. Culture crisis is engendered not so much by changes in culture content as by disturbances in culture structure which generate a condition of imbalance in one or more essential dimensions of the culture and generate thereby a strain through the whole structure.

In an acculturation situation, aside from extermination or forced dispersal of the culture group, the factors most deeply disturbing to the balance of an optimum or near-climax type of culture thus seem to be intrusive influences which dislocate the logico-esthetic integration of the symbol system with the total environment. Next in importance as radically disturbing to such a culture type are attacks or influences which bring about a severing of the bond between the culture group and its geographic environment. Such radical disturbances may operate as determining factors in disintegrating the culture and the conditions which foster its particular type of personality. Such cultural shocks—the deep disturbance of the symbol system, throwing off balance the distinctively human component of the culture, and the severance of the life line between man and nature whereon the culture developed—engender major crises. If not resolved, such crises may be fatal to the cultural whole and to the personality type it fosters. Somewhat less radical in effect, since they do not necessarily disintegrate the culture quickly—although they may do so in the long run—are alien influences which throw the sociological structure out of balance by attempting to superimpose incompatible political or economic systems.

Thus this research project suggests that in broad perspective, acculturation problems are problems in the dynamics of culture structures. A culture structure may endure, it appears, long after many of its outer accoutrements have disappeared or changed almost beyond recognition. Furthermore, the findings underscore and clarify the close relationship between acculturation problems and practical administrative problems of the community. They indicate that, basically, problematic situations of community administration may be reduced to scientific problems in culture structure analysis. In other words, it is the culture structure of a community in environmental context that sets the form of the administrative problem of that community from the viewpoint of community welfare. It follows, for example, that the integrative type of governmental administration, effectively implemented at the community level by social action research (*3, 9*) may be expected to be successful and psychologically healthy in human terms, from the long range community welfare viewpoint, because it allows the group to function by means of the structures of its culture in environmental context and to find its own solutions to new problems mainly through those structures. An integrative community administration and social action research allow indigenous solutions, indigenously structured. On the other hand, exotic, arbitrarily imposed types of administration may be expected, in the long run, to be unsuccessful and psychologically unhealthy in human terms because they attempt to superimpose arbitrary, rigid, and foreign culture structures on the community and tend thereby to dislocate indigenous structures and to engender culture crises.

According to the holistic, community-centered approach which emerges from the findings, the applied social scientist's primary role is viewed, not as one of adjustor, mediator, or trouble-shooter, but rather as one of diagnostician and integrative leader in cooperation with the administrators and the residents of the community itself. Such an approach, it should be noted, logically implies that community governmental administration shall be designed to *serve* the community, that its personnel shall be selected and professionally trained according to the biosocial personality needs and trends and the resources of the

particular local area, tribe, or community wherein they are to serve. It logically implies, furthermore, that administrative organization shall be decentralized to the extent that creative community administration is made possible, encouraged, and rewarded.

The findings, therefore, logically point to an integrative, democratic type of long range administrative policy, implemented by a program of social action research, as appropriate and effective in promoting the welfare of the Hopi community and helping to resolve the Hopi crisis, and they explicitly define the structural foundations whereon such an administrative policy and program, if it is to be effective, has to be built.

Finally, we are given a clue as to the kind of community planning and self-cultivation that may be required for the development of enduring peace and mutual well-being in the world. The inference is that social planning need no longer be envisaged as "management" in either the gross meaning of the term or any of its subtle refinements. It may be viewed as self-discipline and self-cultivation.

> According to this view . . . social planning would become a function of cooperative action research, initiated and implemented by the society (or the community) itself. In a self-perpetuating process of discovery, during which the members of the group come to understand their distinctively *human* potential, through the cooperative leadership of social scientists and with the aid of physical and biological scientists, the society's self-made plans might become actualities. Men would be able to discover for themselves through their own experience that by cooperating with one another and with the world of nature *as human beings*—as systematic symbol-builders and symbol-integrators—they might grow in the course of time to their full stature in a pluralistic world, logically and esthetically articulated for mutual prosperity and peace [reference 7, p. 63].

Hence from the inquiry have emerged significant clues regarding the development of universal, pluralistic, local community norms and methods for their implementation, whereby the findings of science may be applied to community-wide and world-wide practical problems—problems of political, economic, social, religious, and psychological import. Discovery and formulation of such pluralistic cultural norms and research methods in the sciences of man, adequate to the needs of the current world crisis, may be expected to open the way for the development of a more mature science of mankind which will have far-reaching practical significance.

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Scientific Coordination in the South Pacific

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THE WELFARE of the island peoples in the South Pacific has become the objective of a six-nation coordinated undertaking known as the South Pacific Commission. Recognizing the mutual nature of many of the problems in the areas they administer, Australia, France, the Netherlands, New Zealand, the United Kingdom, and the United States have joined in organizing this commission to ". . . encourage and strengthen international cooperation in promoting the economic and social welfare and advancement of the peoples of the non-self-governing territories of the South Pacific region. . . ."

A Research Council has been established as an integral part of the commission. Four specialists have been engaged to devote full time to the undertaking: *L. G. M. Baas Becking,* a distinguished Dutch scientist, is research director; *E. Massal,* a French medical expert, is head of the health section; *H. G. MacMillan,* an economics specialist from the United States, is head of economic development; and *H. E. Maude,* anthropologist and former British colonial administrator, is head of social development. Other specialists will be retained to implement specific projects as the need arises.

Projects to further the aims of the commission are proposed after research by the council experts. They not only investigate personally the needs of the area but also call on administrators and others cognizant of the needs in the various territories to make recommendations. One such extracouncil source of suggestions was the Seventh Pacific Science Congress held in New Zealand early in 1949. Council members are also guided by recommendations outlined by the commissioners representing member governments. Proposals made for projects are submitted for final approval to the commissioners, who assemble for sessions twice a year. Projects which receive concurrence of the commissioners are referred back to the Research Council and the secretariat for implementation. The four full-time members of the council are further assisted by a body of associate members; the full council meets annually to consider problems and needs of the South Pacific and to pass on projects to be submitted to the commissioners. The Council at present includes *Sir Peter Buck,* director of the Bishop Museum, Honolulu, honorary consultant; and five members each of three sections: Health—*J. M. Cruickshank,* inspector-general, South Pacific Health Service, Suva; *J. A. C. Gray,* medical officer, U.S.N., American Samoa; *J. C. Lopdell,* chief medical officer, Western Samoa; *J. T. Gunther,* director of public health, Papua-New Guinea; and *M. E. J. M. Heckenroth*; Economic Development— *F. Bugnicourt,* director, Institut francais d'Oceanie, Noumea; *J. G. Crawford,* director, Bureau of Agricultural Economics, Canberra; *D. R. Eden,* general manager, New Zealand Reparation Estates, Western Samoa; *B. E. V. Parham,* senior agricultural officer, Fiji; and *K. A. Ryerson,* University of California; Social Development— *E. de Bruyn; Maurice Grangié,* director of education, New Caledonia; *F. J. Grattan,* secretary of Samoan affairs, Western Samoa; *W. C. Groves,* director of education, Papua-New Guinea; and *Howard Hayden,* director of education, Fiji.

Present associate members have been appointed for the calendar year 1950. The annual meeting of the Research Council for 1950 is tentatively set for August.

At the May 1949 session of the commissioners 28 research projects submitted by the Research Council following its annual meeting in April were approved for action. Some of the projects are of an immediate nature; others will be developed on a long-time basis. The projects in brief are as follows:

Health

H.1. Project for improving, extending, and speeding up the collection and dissemination of epidemiological intelligence in using temporarily the facilities of the South Pacific Health Service in Suva. The adoption of the project was made subject to the concurrence of the inspector-general of the South Pacific Health Service. Project for standardization of the quarantine regulations.

H.2. Research in the preparation of suitable infant food during the weaning period; food to be prepared safely in a village community from the usual staples and accessories.

H.3. Appointment of a special team to compare (1) the different antigens and methods used in tuberculin tests and (2) the radiographic appearances in different races at different ages, with a view to producing simple techniques suitable for use under field conditions.

H.4. Establishment of liaison between the various

field groups actually working on filariasis and elephantiasis problems and research to determine further the specific investigations needed on these diseases.

H.5. Collection of the existing data on diet and nutrition of communities and individuals.

Economic Development

E.1. The introduction of economic plants from without the area or transfer from within for study and improvement in special gardens and arboretums looking to improvement, saving, and availability of such plants for distribution.

E.2. Review and summary of the information on cash crops to make available the accomplishments in production, cultural, and processing techniques, and their place in area economy, with an estimate for the future of cacao, rice, and the coconut and its principal product, copra.

E.3. Improvement in tropical pasture grasses leading to improved animal nutrition and associated mixed farming to the end of broadening and raising standards in human diet and nutrition.

E.4. Preliminary to a general land-use project in connection with conservation of resources, a pilot land-use survey is to be undertaken to point the way in the establishment of hydrological and forestry reserves, erosion control, identity of crop and pasture lands, and possible soil classifications.

E.5. An attempt by cooperative agreement to secure area standards in the grading and quality of plant products to the end of improvement in quality and a protection of grower, shipper, carrier, and buyer in transactions involving perishable or semiperishable plant products. Adoption made on understanding that it referred to all agricultural products.

E.6. A study of atoll and low island economy, designed to improve cash and subsistence crops and handicrafts to widen commercial opportunity and provide greater security for island peoples.

E.7. A study of fishery methods in their many indigenous and commercial aspects. The Indo-Pacific Fisheries Council will be asked for guidance in the several divisions of fishery improvement.

E.8. An examination of the diet of indigenous peoples with the objective of amplifying it; and the study of the kinds of working tools needed for mechanical skills, both with the aim toward better subsistence economies.

E.9. The expansion of biological controls by cooperative and other means, to effect the control of the mosquito, of insect pests that attack economic plants, and of weeds, and to develop plant hygiene and extend rodent control.

E.10. A proposal to discover ways of making available commercial credit for the development of agricultural, industrial, and commercial enterprises, in the hands of indigenous peoples.

E.11. Cooperative acceptance of the proposed Food and Agriculture Organization plan to carry out an agricultural census in 1950.

E.12. Solicitation of favorable consideration by authorities of the Colonial Development Fund for certain new research projects to be carried out by the Fiji and Western Pacific Research Council.

E.13. Request directed to member governments for a statement of the principal research investigation now in progress or contemplated by their recognized institutions, particularly in the field of animal husbandry, and all technical aspects of land use having implication to the area of the South Pacific Commission.

Social Development

S.1. A survey of the facilities for professional and technical training in the South Pacific, with a view to future development.

S.2. The use of visual aids in education among island peoples.

S.3. A study of the most suitable techniques for teaching reading and writing in the area.

S.4. The convening of a Conference of Educationists, to study educational needs and problems in the various territories.

S.5. A review of research in social anthropology, with emphasis on what still needs to be done.

S.6. A survey of work done and still required in the field of linguistic research.

S.7. The cooperative movement in the South Pacific and its development.

S.8. Determination of the most suitable building types for the various climatic zones and conditions in the area.

S.9. Pilot projects for community development in two selected areas.

S.10. The preservation of archaeological sites.

In addition to the foregoing projects, the commission decided that expert statistical assistance was needed and authorized the appointment of a qualified statistical officer.

Steps were undertaken during 1949 to implement the various projects, progress in some cases being delayed by lack of qualified personnel and in others by the need for further study and research. Three projects in social development and one in health were put into operation, however, during 1949.

The project for dissemination of epidemiological information (H.1) was started in November 1949 through cooperation with the South Pacific Health Service. This coordination of effort is in keeping with the definite policy of the commission to work through existing services and organizations wherever possible in order to avoid duplication of effort.

In social development the project in anthropology (S.5) has been undertaken by A. P. Elkin, of the University of Sydney and the Australian Research Council. Project S.6, involving linguistic research, is being carried out by A. Capell, of the University of Sydney, a world authority on oceanic languages. The project on visual aids (S.2) is being done by A. L. Moore, consultant on visual aids for the Office of Education, on loan from the Commonwealth of Australia.

Project S.1, which has to do with investigating the facilities for professional and technical training in the South Pacific, was begun in January 1950, R. W. Derrick, supervisor of technical services in Fiji, having been obtained to undertake the survey. Howard Hayden, director of education in Fiji, who is also an associate member of the South Pacific Commission Research Council, will undertake the mass literacy project (S.3).

Territory	*Number of Delegates*	*Number of Alternates and Advisers*
American Samoa	2	2
British Solomon Islands Protectorate	2	2
Cook Islands (including Niue)	2	2
Ellice Islands	2	2
Fiji	2	2
French Oceanic Establishments	2	2
Gilbert Islands	2	2
Nauru	1	2
Netherlands New Guinea	2	2
New Caledonia and Dependencies	2	2
New Guinea (Australian Trust Territory)	2	4
New Hebrides	2	2
Papua	2	4
Tokelau Islands	1	...
Western Samoa	2	2
Kingdom of Tonga	2	2
Totals	30	34

At the head of the South Pacific Commission is a body of commissioners, two designated by each member government. Each member government has one vote under terms of the agreement, the senior commissioner casting the ballot. Sessions of the commission are held usually in May and October. The May 1950 session is scheduled to be held in Suva, Fiji, immediately following the first South Pacific Conference.

The South Pacific Conference was designed to bring the peoples of the area directly in contact with the commission. Delegates are chosen from among the island peoples of the non-self-governing territories of the region. For the first conference, to be convened at Nasinu, near Suva, Fiji, in April 1950, the total number of delegates and advisers to be sent by each administration has been limited. Selection of delegates from each territory will be made by the administration concerned.

Although the independent Kingdom of Tonga is outside the scope of the commission, invitation has been extended to the government of the kingdom to participate in such commission activities as may be mutually beneficial. By virtue of this policy, Tonga has been invited to join in the South Pacific Conference. Territories and allotted delegates and advisers for the first conference are shown.

Delegations will prepare introductory papers on area problems for presentation at the conference. Exhibitions of portable items, such as handicrafts, fishing gear, photographs, and the like, will be arranged for display during the conference by the delegations. Background papers have been allotted for preparation by delegates from various administrations as follows: under public health—"Mosquito Control," Australia; "The Healthy Village," United States; under social development—"The Village School," New Zealand; "Vocational Training," the Netherlands; "Cooperative Societies," United Kingdom; under economic development—"Fisheries Methods," France; "Improvement and Diversification of Food Crops," Australia.

Eight observers from outside groups have been authorized to attend the conference. Priorities will be given in this order: Missions (4), Pacific Science Board, Institut francais d'Oceanie, United Nations, Australian National Research Council, World Health Organization, Food and Agriculture Organization.

Since the conference is a body auxiliary to the commission with advisory powers, it is anticipated that out of the discussion and interchange with the delegates will come suggestions of value in planning future projects in the area. Under the provisions of the agreement signed at Canberra, Australia, February 6, 1947, establishing the South Pacific Commission, the South Pacific Conference will be held every three years.

The area served by the conference includes those territories east of and including Netherlands New Guinea and south of the equator, and in addition the Gilbert Islands. New Zealand and Australia are not included in the scope of the commission and Easter Island is also excluded. Between two and three million non-self-governing islanders are concerned, the

most of them being on the vast island of New Guinea, which comprises 330,000 of the 371,000 square miles of land in the conference area.

Financial support for the commission comes from the member governments, contributions being fixed by the agreement which created the commission. Contributions to the annual budget are made as follows: Australia, 30 percent; France, 12½ percent; the Netherlands, 15 percent; New Zealand, 15 percent; the United Kingdom, 15 percent; the United States, 12½ percent. The budget for 1950 is slightly in excess of 144,000 pounds sterling.

Technical assistance to the various territories in its area is of vital concern to the commission. Although the organization is entirely separate from the United Nations, liaison is maintained with the UN and such of its affiliated and subsidiary bodies as will have common concern in the South Pacific. This is particularly true in regard to the World Health Organization, the Food and Agriculture Organization, and the Indo-Pacific Fisheries Council. The S.P.C. is patterned after its successful prototype in the Western Hemisphere, the Caribbean Commission, several of the same member governments being concerned.

Now that the South Pacific Commission has gone through its organizational period and has established a concrete program of activity, it can be expected that there will be an accelerated attack on the problems of the peoples of the South Pacific. Within the present year results should be increasingly evident, although many of the problems of the area are of such a nature that solving them will require cumulative effort over a period of years rather than months. The significant fact is that six nations are working cooperatively to meet the common needs of the island peoples in the territories of the South Pacific in which they hold political responsibilities.

Technical Papers

The Recovery of Auditory Nerve Action Potentials after Masking

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The action potentials of the auditory nerve as recorded from the round window of the cochlea in the anesthetized cat or guinea pig are subject to masking by other sounds. This is most easily demonstrated in the response to clicks of low intensity, where the action potentials are well developed and sufficiently separated in time from the aural microphonic for the two components to be readily distinguished. In the presence of a tone or noise of suitable intensity the neural component is immediately reduced in amplitude, whereas the microphonic remains unaffected.

Masking has been explained by Stevens and Davis (*6*) as a necessary consequence of the properties of the auditory nerve: the masking sound excites the nerve fibers and keeps them refractory, so that they are unable to respond synchronously to the clicks. The authors qualify this explanation, however, by stating that such a "line-busy" effect is not necessarily the only mechanism involved in masking.

We have recently observed that when a brief noise or tone is sounded during stimulation of the ear by a train of clicks, the action potentials of the click response, which must represent the sum of the activity in many fibers, recover their full amplitude only after 0.1 sec or more, a period far in excess of the maximum possible duration of the refractory period of the nerve fibers. Here, then, is a phenomenon which must represent a continuation of the masking process, but which cannot be explained on the basis of the refractory state alone. In

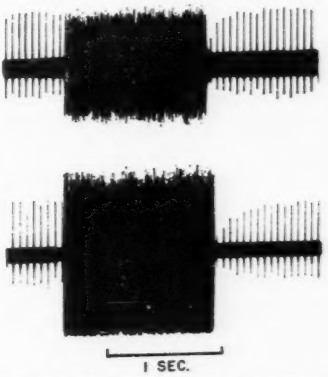

FIG. 1. Photokymograph records of recovery of action potentials of click response from round window after masking by thermal noise for 1.3 sec. Above, noise at 50 db relative to 0.0002 dyne/cm²; below, noise at 70 db. Clicks about 30 db above threshold for action potential. Cat, pentobarbital anesthesia.

Fig. 1 the action potentials return to full size approximately 0.3 sec after a thermal noise[1] of 50 db (as measured at the cat's ear by the General Radio sound level meter) has been turned off, and approximately 1 sec after a noise of 70 db. The rate of recovery after masking at 50 db is independent of the duration of the noise and is unaffected by repetition. When the intensity of the masking sound is increased recovery becomes slower,

[1] That is, noise of wide frequency spectrum, often called "white" noise.

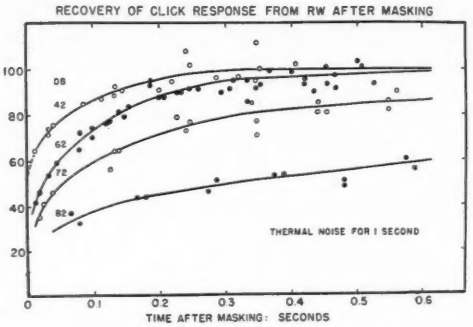

FIG. 2. Recovery of action potentials of click response from round window after masking by thermal noise at levels indicated for 1 sec. The points are plotted from measurements of series of 2 to 5 records similar to those in Fig. 1. Average height of responses immediately before masking taken as controls. Cat, pentobarbital anesthesia.

as illustrated in Fig. 2. Above 70 db there is a cumulative impairment of the response, and an increase in the duration of the masking further delays recovery. After exposure to noise at 95 db for 1 min the neural component is temporarily eliminated and even the microphonic is slightly reduced in amplitude. In 3 to 4 min, however, both components recover completely.

Tonal stimulation with frequencies in the vicinity of 4000 cycles per sec is particularly effective, both in masking the click response and in causing delayed recovery after masking. This may mean only that the click activates predominantly those nerve fibers which respond to such high frequencies; on the other hand, it is in accord with the known sensitivity of the human ear to the injurious effects of this portion of the audible spectrum. After exposure to 4000 c at 112.5 db for 1 min, the microphonic is reduced by approximately 30% and the action potentials are abolished for at least ½ hr.

Since the refractory period of the auditory nerve fibers, which is estimated by Davis (*6*) as approximately 1 msec, is far too short to account for the slow recovery of the action potentials after masking, we were at first inclined to attribute this delay to the time required for relaxation of the intra-aural muscles, which we supposed to be reflexly contracted in response to the masking sound. This explanation is incorrect, however, for two reasons: 1) At moderate levels of masking only the action potentials recover slowly, whereas the microphonic remains at full size throughout; both components should be affected in the same way by a change in tension of the intra-aural muscles. 2) When the guinea pig gives a brief contraction of these muscles during stimulation with a low tone and a train of clicks, the microphonic response to the tone is temporarily suppressed but the responses to clicks show little if any change in amplitude. This is illustrated in Fig. 3, where the effect of a spontaneous contraction is compared with the masking action of noise at 70 db. From this one may conclude that the intra-aural reflex causes little or no loss in the transmission of the click stimulus across the middle

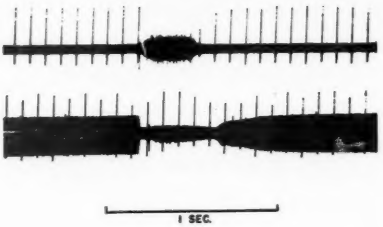

FIG. 3. Above, recovery of action potentials of click response from 3rd turn of cochlea after brief burst of noise at 70 db. Below, effect of spontaneous contraction of intra-aural muscles on responses to 500-cycle-per-sec tone and train of clicks, both continuous throughout record. Guinea pig, pentobarbital anesthesia.

ear and therefore cannot be responsible for the slow recovery of the action potentials after masking.

Our observations, which indicate that masking is not a matter of maintained refractory state alone, unfortunately do not reveal the nature of the other factors concerned in masking. Intracochlear inhibition as described by Galambos (*3*) may be involved, but can scarcely account for the prolonged effect of more intense sounds. The change need not reside in the nerve fibers, but may represent a temporary depletion or "equilibration" (*2*) of the mechanism which transmits excitation from the hair cells to the fiber terminals, so that excitation becomes inadequate for most of the fibers previously responding to the clicks. This mechanism appears from other evidence, such as the remarkable sensitivity of the auditory nerve to anoxia (*6*), to be the vulnerable link in an otherwise rugged system.

The more lasting reduction of the neural response after intense stimulation is probably the electrophysiological correlate of auditory fatigue or temporary deafness in man after exposure to loud sounds.[2] Acoustic injury has previously been studied in animals only after exposures to intensities sufficient to affect the microphonic response or to cause structural damage to the organ of Corti (see references *1, 4, 5, 7,* among others). In its reversible form it now appears to be an extension in time and in degree of the process underlying auditory masking.

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[2] A more intensive study of this aspect of the phenomenon has been made by Rosenblith and Galambos following their independent discovery of it at the Harvard Psycho-Acoustic Laboratory. Their findings and ours were reported at the November, 1949 (St. Louis) meeting of the Acoustical Society of America.

The Effect of Exposure to Loud Tones upon Animal and Human Responses to Acoustic Clicks[1]

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Auditory fatigue can be defined broadly as a more or less temporary loss of auditory sensitivity due to previous auditory stimulation. There seem to be several types of fatigue, characterized by different time courses, degrees of reversibility, and frequency patterns of impaired response, but the great variability in reported data precludes a precise definition of these types. The advent of electrophysiological recording from the ear suggested that measurement of the electrical output of the ear might yield an objective index of fatigue. The results obtained in previous studies of cochlear potentials, however, were largely disappointing. A depression of the electrical response was usually obtained only when the stimulation was intense enough to cause damage to the responding mechanism.

During World War II more data on the effects of exposure to loud sounds in animal and man become available (*1, 3*). But renewed efforts to correlate temporary deafness in man with changes in the "electrical audiogram" (*2*) in animals again met with failure.

The electric potentials recorded from electrodes in contact with the cochlea are made up of at least two components: (1) the so-called cochlear microphonic, which reproduces fairly accurately the waveform of the acoustic stimulus and (2) the action potentials, presumably derived from neural structures in the lower auditory pathways. In general, when the electrical response of the ear to pure tones is recorded (and this was the case in the studies referred to above) the microphonic potentials swamp the neural components. On the other hand, in the responses to impulsive stimuli, such as sharp clicks at low and moderate intensities, the microphonic and the neural components may appear separated in time.

A typical response to a click recorded by means of a wire electrode placed near a cat's round window is shown in Fig. 1 (upper right-hand corner). The acoustic click is produced by feeding an electric pulse of 0.1 msec duration to a Permoflux (PDR-10) earphone.

[1] This research was carried out under Contract N5ori-76 between Harvard University and the Office of Naval Research, U. S. Navy (Project NR 142-201, Report PNR-83). Reproduction by the U. S. Government for any purpose is permitted.

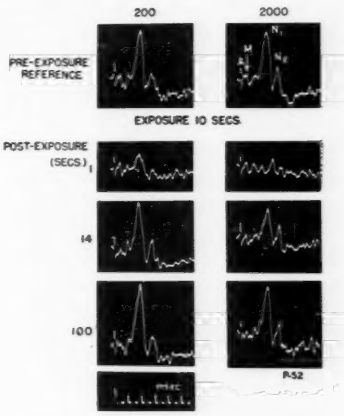

FIG. 1. Effect of exposure to loud tones (200 and 2000 cycles per sec) upon the response to clicks as recorded from the round window. The top line shows typical responses to weak clicks (about 15 db above human threshold). The earliest regular upward deflection on all records (*A*) is an artifact of 0.1-msec duration caused by the electric pulse delivered to the earphone. *M* is the earliest and in most cases most prominent microphonic component. N_1 and N_2 are the so-called first and second neural components. Typical post-exposure pictures, taken after exposures to tones of 200 and 2000 c for 40 sec at a sound pressure level of about 105 db, are presented. Note: (a) both neural components are reduced in approximately the same proportions; (b) recovery is quicker after exposure to the 200-c tone and the first neural component becomes "supernormal."

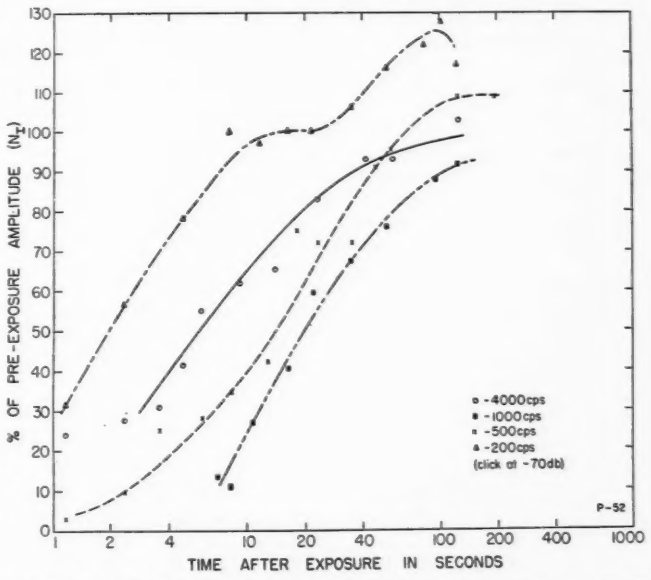

FIG. 2. Effect of exposure to various frequencies. All exposures were for 10 sec at a sound pressure level of about 105 db. The course of recovery of the first neural component is traced by comparing its amplitude at any given time after exposure with the standard or pre-exposure amplitude. Note the "supernormality" after recovery from exposure to tones of 200 and 500 c.

If the cat's ear is exposed to loud tones having a sound pressure level (SPL) of about 105 db and the responses to clicks before and after exposure are compared, significant changes are evident (see Fig. 1).[2] A sizable temporary reduction in the amplitude of the neural components follows even a relatively short exposure to moderately intense tones. Furthermore, the neural response to weak clicks is abolished for a time. Thus the exposure not only reduces the neural response to clicks; it also raises the threshold of the neural components. The course of recovery depends upon the frequency of the exposure tone (see Fig. 2) and it depends also, of course, upon the intensity and the duration of the exposure. For example, after one fairly severe exposure (2000 cycles per sec for 15 min at 125 db SPL) 10,000 sec elapsed before both components returned to about 85% of their pre-exposure amplitude. During the same period, however, the amplitude of the most prominent microphonic component showed only minor fluctuations.

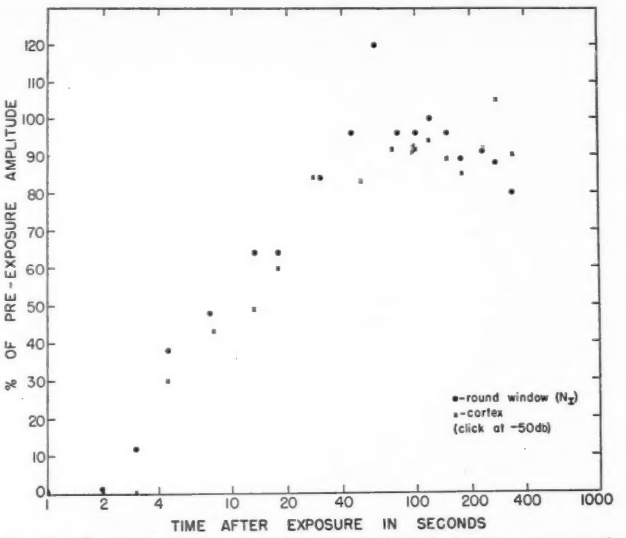

FIG. 3. Comparison between recovery at round window and recovery at the auditory cortex. The exposure stimulus was a 500-c tone presented for 60 sec at a sound pressure level of about 115 db.

At the auditory cortex the size of the electrical response to weak and moderately loud clicks is related monotonically to the acoustic input. It seemed worth while, therefore, to check the effect of an exposure to loud tones upon this cortical click response. Fig. 3 shows that the recovery curves for the so-called first neural component at the round window and for the cortical click response are hardly distinguishable.

Our data on the effect of exposure upon the size of the neural component show that the effect is greatest for the weak clicks and decreases as the intensity of the click increases. This may be related to the findings of Davis and his collaborators (*1*), who have shown that, whereas exposure to loud tones may elevate the threshold, the apparent loudness of sounds 80 to 100 db above threshold remains unchanged.

So far, we have been concerned with changes in the magnitude of a neural response to a given supraliminal stimulus. Auditory fatigue in man, on the other hand, is usually defined in terms of a change in threshold to a stimulus after exposure. Although these two manifestations of auditory sensitivity may represent different phenomena, there is good reason to believe that there are common physiological factors at work.

It is of interest, therefore, to inquire what happens to the human threshold for clicks after exposure to loud tones. Since no data were available on this point, we undertook the following experiment. After exposing an observer to pure tones of different frequencies, intensities, and durations, we presented a group of four clicks every 3 sec. The four clicks within each group were at different intensities separated by steps of 4 db. The number of clicks the observer reports permits an estimate of his threshold. We find that the threshold for clicks is raised by about 10 db after exposure to certain tones (e.g., 250 and 500 c for 2 or 3 min at 130 db SPL). The ear recovers rapidly and is normal after about 40 sec, a time not unlike that required for the cat's neural response to return to normal (cf. Fig. 2). After this recovery, however, the threshold goes up again by slightly less than 10 db, and there follows a long recovery period whose duration depends upon the frequency and duration of the exposure tone.

To summarize: Exposure to loud tones modifies the response to clicks as recorded from the round window of cats. The microphonic component shows little or no change, either to clicks or to the exposure tone itself. The neural components of the response to clicks are reduced in size immediately after exposure, and the course of their recovery depends upon the intensity, frequency, and duration of the exposure tone. There is a striking parallel between the recovery of the first neural component recorded at the round window and the recovery of the neural response recorded at the auditory cortex. Although it is hazardous to compare human thresholds with magnitudes of neural responses in animals, our preliminary findings suggest the possibility of a relation between these two phenomena.

Observations similar to some of those reported here have been made independently, and approximately during the same period, by Hawkins and Kniazuk at the Merck Institute for Therapeutic Research. Both groups re-

[2] Preliminary observations on guinea pigs confirm the data obtained from cats. We are indebted to Drs. H. Davis and C. Fernandez for their assistance in making these observations on guinea pigs.

ported their findings at the November 1949 (St. Louis) meeting of the Acoustical Society of America.

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Identification of Estrogens by Paper Chromatography

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In animals, estrogenic steroids occur almost invariably in mixture, but in spite of the great differences in their biological activity, chemical and biological assays are usually reported in terms of a single estrogen, owing to the technical difficulties in their separation and identification. Partition chromatography on paper can be used for separating closely related compounds, provided they show a difference in distribution coefficients and can be detected in small amounts. This technique has been applied successfully to the identification of ketosteroids by Zaffaroni *et al.* (*3*). A simple and rapid procedure for the identification of minute amounts of estrone, estradiol, and estriol by paper chromatography is presented here, which may be applicable to differential determination of estrogen content of biological specimens.

Colored derivatives of the estrogens are prepared by coupling with diazotized *p*-nitrobenzeneazodimethoxyaniline (Fast Black Salt K[1]). This reagent, proposed by Marx and Sobotka (*1*) for the determination of equilenin and dihydroequilenin, was reported as not coupling readily with estrone, estradiol, or estriol. However, K salt can be made to react with these steroids in a strongly alkaline medium, either by heating the mixture or by allowing it to stand overnight. A saturated aqueous solution of K salt is prepared freshly and filtered.[2] The estrogens are dissolved in absolute ethanol and 0.1 ml of each solution, containing a minimum of 3 μg of any steroid, is placed in a test tube, and a tube containing 0.1 ml alcohol is used as a blank. Then 0.2 ml of the diazo reagent and 0.1 ml of 20% Na_2CO_3 solution are added and the contents of the tubes are mixed and heated in a boiling water bath for 10 min and later cooled in water. To check evaporation, a glass bulb is placed in the mouth of each tube. Coupling also takes place if the mixture is allowed to stand overnight. The color deepens on standing and, once developed, it is stable for weeks. To extract the dyes, 0.2 ml benzene is added, and the tubes are shaken vigorously. The contents of each tube are drawn up into a medicine dropper with a fine tip, allowed to separate, the aqueous phase is expelled, and the entire benzene solution is applied to the filter paper.

[1] Emil Greiner Co., New York City.

[2] The solution keeps at least a day at room temperature and several days at 5° C, but it should be filtered before use to minimize the blank.

TABLE 1

COLOR AND LOCATION OF SPOTS IN THE PAPER CHROMATOGRAM OF ESTROGENS AND RELATED COMPOUNDS

Compounds	Color of spots	R_f values
Estrone*	purple	0.95 ± .03
Estradiol*	"	0.81 ± .06
Estriol*	"	0.07 ± .03
Estrone and estradiol†	"	0.96 and 0.85
Estrone and estriol†	"	0.96 and 0.09
Estradiol and estriol†	"	0.85 and 0.09
Estrone, estradiol, and estriol†	"	0.96, 0.85 and 0.09
Estrone sulfate‡	"	0.95
Equilin§	"	0.96
Phenol	red	0.50
Catechol	yellow	0.00
Diethylstilbesterol‖	none	...
1-Methylestradiol diacetate§	purple	0.81 and 0.96
Dehydrocorticosterone acetate‖	yellow	0.95
Progesterone*	"	0.74
Pregnanediol¶	none	...
Dehydroisoandrosterone acetate*	"	...
cis-Testosterone**	yellow	0.21
Isoandrosterone††	none	...
Δ^4-Androstene-3,17-dione††	yellow	0.60 and 0.97
Δ^5-Androstene-3,17-dione§	none	...
$\Delta^{1,4}$-Androstadiene-3,17-dione§	"	...

* Courtesy of Schering Co.
† Equal parts.
‡ Courtesy of Ayerst, McKenna, and Harrison, Ltd.
§ Courtesy of Dr. Martin I. Rubin, Georgetown University.
‖ Merck and Co., Inc.
¶ Bios Laboratories, Inc.
** Courtesy of Ciba Pharmaceutical Products, Inc.
†† Courtesy of Organon, Inc.

The solvent mixture found most suitable for the separation of the three dyes is prepared by mixing 200 ml toluene, 100 ml petroleum ether (boiling range 35°–60° C), and 30 ml ethanol with 70 ml water in a separatory funnel. After overnight equilibration, the water layer is drawn off into an open vessel and used in keeping the atmosphere of the chromatographic chamber saturated with respect to this phase. Equilibration and chromatography are carried out in an air-conditioned laboratory kept at 75° ± 3° F. The ascending method of chromatography (*2*) is used. The solvent mixture is placed directly on the bottom of a cylindrical glass jar, 12 in. high and 8 in. inside diam. The vessel, a so-called museum jar, has a flat glass cover with a rubber sealing ring and can be made airtight by means of a screw clamp. The bottom is raised in the center, which results in a saving of solvent. Sheets of Whatman filter paper No. 1, 18½ × 22½ in., are cut in half, and subsequently either cut into strips, which are suspended from hooks inside the lid of the jar, or, for up to 15 chromatograms, stapled together as cylinders 11¼ in. high and 18½ in. in circumference.

The paper is held over a hot plate and the benzene solution of the dye is placed on a pencil line, 1½ in. from the bottom edge. By repeatedly delivering small amounts of solution from the medicine dropper the entire benzene solution can be evaporated without making the spot un-

duly large. The solvent is allowed to rise to a prescored pencil line, 10 in. from the bottom edge of the filter paper. This takes 1½ hr. The blank produces a yellow spot on the finish line, and estrogens give in addition a purple[3] spot.

Table 1 gives the average R_f values of spots obtained by chromatographing estrone, estradiol, and estriol, singly and in mixture. As expected from the theory of partition chromatography, the R_f values of the three compounds decrease with increasing number of hydroxyl groups. Mixtures are readily resolved and identified. Only steroids containing a phenolic group give purple spots; this includes the equine estrogens. Diethylstilbestrol does not give the test. Double spots indicate a chemical change during the test, e.g., hydrolysis, or an impurity in the compound tested. Certain 3-ketosteroids, having a double bond in ring A, give yellow spots.

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[3] Absorption maximum around 540 mμ.

Enzymatic Activities of Isolated Normal and Mutant Mitochondria and Plastids of Higher Plants

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The chloroplasts of higher plants derive from the mitochondrial elements of the cell (*4, 6*), and possess extranuclear hereditary entities (chondriogenes [*1*]). Although it has been shown that isolated chloroplasts carry oxidizing enzymes (*7*), and that the activity of these enzymes may be deranged following chondriogene mutation (*9*), we are not aware of any reports dealing with the enzymic properties of the undifferentiated mitochondria in comparison with the chloroplasts. Furthermore, it is important to know whether plant plastids and mitochondria carry all or the major part of certain respiratory enzymes, as do animal mitochondria (*3, 5*). It has been demonstrated that certain animal neoplasms are characterized by peculiarities in mitochondrial enzyme systems (*2*). Besides providing more information on extent of homology between plant and animal mitochondria, such data should also be of value in determining the role of mutant mitochondria in cell pathology, particularly in relation to disturbed metabolism and growth.

The genetically controlled plant material consisted of freshly harvested leaves of *Nicotiana tabacum* L. and *Lonicera japonica* Thunb.[1] The variegated (plastid mutant) *Nicotiana* material was secured by crossing an emasculated plant carrying the desired line of mutant mitochondria with a normal male parent. The F_1 plants were of the Maryland Medium Broadleaf type and, by virtue of somatic segregation of mitochondria, the leaves of the same plant often contained mesophyll cells with either normal, mutant, or normal and mutant mitochondrial elements. These mutant mitochondria are sexually inherited in non-Mendelian fashion through the female gametes and develop into chlorophyll-deficient plastids with cytological characteristics similar to type IIc variegations (*8*). The enzymic activity of centrifugally purified plastids and mitochondria of this material was compared with similar elements of normal cells.

Extractions were carried out at 5° C by grinding fresh leaf tissues in a Waring Blendor, in approximately four parts by weight of unbuffered sucrose solution (0.15 to 0.5 molar), and filtering through glass wool on a Buchner funnel. The filtrate (a cell-free homogenate) was compared with respect to its activity with fractions of two aliquots, fractionated by differential centrifugation in a Servall Superspeed angle-head centrifuge. One aliquot, subjected to 19,000 *G* for 20 min, yielded a "total pellet" and a supernatant devoid of microscopically visible particulates. The other aliquot, subjected to fractional centrifugations in order to remove nuclei, etc., yielded on sedimentation at 120 *G* for 10 min a pellet composed almost entirely of plastids, or plastids and starch. The plastids were sometimes subjected to additional cycles of suspension and sedimentation in fresh sucrose solution. The mitochondrial fraction was obtained by centrifugation of the supernatant at 19,000 *G* for 20 min following removal of the plastids. The mitochondria formed a compact brownish-gray pellet. Microscopically, they appeared mainly as colorless granules varying from 0.3 to 1 μ in diam. Some plastid fragments were always present in this fraction.

Considerable variability in enzymic activity, determined by Warburg technique, was encountered in leaves from plants of different ages or growth conditions. This variability was diminished by making comparisons between normal and mutant tissues derived either from equal areas of mutant and normal tissue of each leaf used, or from different leaves of approximately the same physiological age. Table 1 presents the results of some representative experiments in which composite tissue samples of normal and variegated leaves of approximately the same age were compared. Since preliminary data showed that the tissue extracts decreased auto-oxidation of the substrates, corrections were not made for auto-oxidation blanks. It was also determined that addition of cytochrome C to PPDA (paraphenylene diamine) did not stimulate oxidation in the absence of tissue fractions.

There is little difference between normal and mutant fractions with respect to the oxidation of PPDA with and without cytochrome C. Pronounced inhibition of oxygen uptake following addition of azide occurred mainly in the fractions containing particulates, indicating that the particulates are the main carriers of the cytochrome system. As would be expected, there was some decrease

[1] Acknowledgment is due to the Department of Botany of the University of Maryland for furnishing greenhouse facilities.

TABLE 1

ENZYMIC ACTIVITIES OF THE HOMOGENATE, TOTAL PELLET, AND SUPERNATANT FROM EQUAL VOLUMES (APPROXIMATELY EQUAL NUMBERS OF CELLS) OF NORMAL AND MUTANT (CONTAINING MUTANT MITOCHONDRIAL ELEMENTS) TISSUES OF *Nicotiana tabacum**

	Homogenate				Pellet				Supernatant			
A.†	Normal		Mutant		Normal		Mutant		Normal		Mutant	
PPDA‡												
1st 25 min	−24.0	−24.0	−36.0	−24.0	− 5.6	− 7.1	− 5.4	− 6.4	−20.0	−19.6	...	−29.2
2nd 25 min	−22.0	−18.8(Az)	−26.0	− 6.0(Az)	− 4.5	− 3.4(Az)	− 4.8	− 3.4(Az)	−22.0	−19.6(Az)	...	−30.4(Az)
PPDA + cytochrome C§												
1st 25 min	−34.4	−36.0	−31.0	−24.8	−16.1	−14.4	−15.4	−15.2	−22.8	−19.8	−24.0	−22.0
2nd 25 min	−26.0	−18.0(Az)	−29.0	−24.0(Az)	−13.8	− 2.9(Az)	−15.2	− 5.2(Az)	−20.6	−20.8(Az)	−22.8	−19.0(Az)
Catechol‖												
1st 30 min	−298.2		−75.8		−80.8		−12.5		−206.4		−74.8	
DOPA¶												
1st 30 min	−170.6		−92.0		−62.4		−13.1		−231.2		−83.2	
B.†												
PPDA‡												
1st 30 min	−23.8	−35.0	−21.4	−22.0	− 6.9	− 8.1	− 7.9	− 9.1	−16.0	−21.4	−16.0	−21.8
2nd 30 min	−16.4	−11.8(Az)	−19.4	−13.2(Az)	− 4.4	− 1.8(Az)	− 9.5	− 2.5(Az)	−14.0	−12.6(Az)	−18.0	...
PPDA + cytochrome C§												
1st 30 min	−32.2	−31.4	−27.0	−31.6	−21.7	−19.9	−18.3	−21.4	−14.2	−20.0	− 9.6	−21.0
2nd 30 min	−26.6	−10.0(Az)	−25.0	−11.4(Az)	−13.8	− 3.6(Az)	−13.9	− 3.7(Az)	...	−14.0(Az)	− 9.6	−11.4(Az)
Catechol‖												
1st 30 min	−129.0	...	−18.8	−20.8	−50.5	−54.7	− 8.2	− 6.9	−77.8	−79.6	−15.0	−14.6
C.†												
PPDA‡												
1st 30 min	−17.2	−21.4	−21.4	−21.2	− 4.4	− 5.6	− 6.1	− 5.6	−18.6	−18.6	−19.8	−22.6
2nd 30 min	−17.2	−16.8(Az)	−16.2	−17.4(Az)	− 5.9	− 4.4(Az)	− 7.4	..	−19.6	−16.4(Az)	−16.0	−18.2(Az)
PPDA + cytochrome C§												
1st 30 min	−24.8	−23.2	−27.6	−27.8	−13.6	−14.0	...	− 9.8	−24.2	−19.8	−12.8	−16.6
2nd 30 min	−22.4	− 5.6(Az)	−23.4	−20.8(Az)	−13.2	− 4.1(Az)	...	− 2.6(Az)	−24.4	−18.8(Az)	−12.8	− 9.6(Az)
Catechol‖												
1st 30 min	−72.8	−68.0	− 7.2	0	−33.6	−34.9	− 0.7	− 0.6	−26.4	−39.2	0	0

* Activities are expressed as μl O_2 consumed per hr per ml homogenate equivalent.

† A, B, and C represent experiments on three separate lots of material.

‡ Paraphenylene diamine (PPDA), 0.02 M. Each value represents a determination on one vessel. Azide (Az), NaN_3, 10^{-3} M, added after lapse of first period.

§ Cytochrome C (mammalian), 10^{-5} M.

‖ Catechol, 0.02 M.

¶ DL-Dopa (dihydroxyphenylalanine), 0.02 M.

in enzyme activity with time. The phenolase activity of extracts of normal tissues was found to be significantly higher than that of comparable mutant tissues. Semi-qualitative colorimetric determinations of phenolase activity in five separate pairs of leaf extracts (addition of catechol, or tyrosine with a trace of catechol) also showed that normal tissues were more active than those of corresponding mutant tissues.

Table 2 presents the range of enzyme activities of isolated plastids and mitochondria from normal and variegated tobacco leaves. In comparing the Qo_2 values of mutant particulates with those of the normal plastids and mitochondria it should be kept in mind that the dry weights per unit area of leaf are lower for variegated than for normal tissues, which fact explains the higher values found for variegated tissues. Nevertheless, the values for phenolase activity for the mutant particulates are much lower than for normal particulates.

A series of comparable experiments were performed with fractions of normal *Lonicera* leaves, yielding data similar to those obtained with *Nicotiana*. Whereas *Nicotiana* fractions did not utilize lactate appreciably above the endogenous rate, *Lonicera* particulates did. Thus in a typical experiment a *Lonicera* homogenate gave a Qo_2 of 0.5 with cytochrome C 10^{-5} M, but without added substrate, and 3.6 with 0.02 M lactate plus cytochrome C. The corresponding values for plastids were 0.1 and 1.3, and for mitochondria 0.8 and 6.7. The supernatant fractions gave no gas uptake with lactate. The gas uptake with lactate as substrate was not decreased by the addition of .001 M azide.

From the data obtained, the following conclusions can

be drawn: (a) The particulate-containing fractions were the only ones in which the PPDA oxidation was markedly stimulated by the addition of cytochrome C in both mutant and normal tissues. (b) The same fractions were the only ones markedly inhibited after addition of azide. (c) Catechol was oxidized by normal tissue fractions at a much higher rate than by the fractions from mutant tissues. (d) The supernatant fraction showed considerable oxygen uptake in the presence of PPDA. This, however, did not involve the cytochrome system, as the addition of neither cytochrome C nor azide had any marked effect on the rate of oxidation.

TABLE 2

RANGE IN ENZYMIC ACTIVITIES OF ISOLATED PLASTIDS AND MITOCHONDRIA FROM NORMAL AND VARIEGATED LEAVES OF *Nicotiana tabacum**

Plastids	PPDA	PPDA + cyto-chrome C	Catechol	Endo-genous
Normal plastids	0.1	2.7	14.1	.5
	2.1	4.1	29.5	.2
	4.0	10.0	...	1.0
Normal mitochondria	2.0	3.7	13.7	.4
	2.6	5.9	18.1	.2
Mutant plastids	2.6	6.8	3.7	0
	1.8	11.2	0	.3
	2.7	11.9	...	.3
Mutant mitochondria	2.4	7.5	3.1	0
	4.1	21.6	0	1.4

* Each horizontal row represents data from one experiment. All activities are expressed as μl O_2 consumed per mg dry wt per hr and are based on duplicate determinations.

In general, the results obtained with *Nicotiana* and *Lonicera* show that both mitochondria and plastids carry all or the bulk of the cytochrome oxidase activity of the cell, thus providing further evidence for the homologous nature of plant and animal mitochondria. Furthermore, the data from *Nicotiana* demonstrate that mitochondrial mutation can result in marked derangement of certain enzyme systems of the cell, and that such abnormalities are apparent in both mitochondria and plastids.

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The Significance of Nonclassical Statistics

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Certain statements by Wiener (*3*) have led to the considerations given here, regarding the conditions under which the Gibbs type of statistics are and are not convenient for describing Newtonian systems. A parallel is traced between this situation and that which is met in wave mechanics, and the conclusion is reached that the success of nonclassical statistics in wave mechanics is not in itself evidence that atomic systems are not Newtonian.

The first statement, p. 110, is:

> In the Newtonian physics, the sequence of physical phenomena is completely determined by its past, and in particular, by the determinations of all positions and momenta at any one moment. In the complete Gibbsian theory it is still true that with a perfect determination of the multiple time series of the whole universe, the knowledge of all positions and momenta at any one moment would determine the entire future. It is only because these are ignored, nonobserved coordinates and momenta that the time series with which we actually work take on the sort of mixing property with which we have become familiar in this chapter, in the case of time series derived from the Brownian motion.

Then at the bottom of p. 117:

> . . . a dynamical system with no input may go into permanent oscillation, or even oscillation building up to infinity, with an undetermined amplitude. In such a case the future of the system is not determined by the past, . . .

Such a system obviously does not conform to the definition of a Newtonian system given in the first quotation. Since Wiener is presumably referring to macroscopic systems, the individual parts of which obey Newtonian laws, his statement implies that a non-Newtonian system may be constructed from Newtonian parts. We are therefore led to question the existence of a system such as he describes.

Certainly some systems which are capable of sustained oscillations do not go into that condition "with no input." A pendulum clock or a gasoline engine requires a starting input comparable in magnitude with the resulting oscillations. Certain types of vacuum tube oscillator, which depend on exact relations among the harmonics, will not oscillate for certain circuit adjustments unless they are subject to a fairly large input disturbance. By suitable design the magnitude of the required input may be reduced to the point where it is practically impossible to bring the system into a condition suitable for oscillations without having them start. Here the starting input may be of either of two forms. It may be a by-product of the adjustment which sets up the oscillatory condition. Here it is obviously determined by the past and nothing non-Newtonian is involved. If we assume that the system can be brought into a condition of unstable equilibrium and left there, then it will remain in that state indefinitely unless it is disturbed by some input. Because

of the regenerative amplification which accompanies this condition, an exceedingly small input will suffice to start the oscillations. However, because the build-up occurs at a finite rate, an infinitesimal input will not become finite in any finite time. Hence a finite though small input is required and the future does depend on the past, particularly as regards the phase of the oscillations.

Thus we conclude that the second quotation is never literally true. However, the nature of the connection between past and future for certain oscillators is so different from that for ordinary mechanical systems that they warrant special consideration, particularly with reference to statistical treatments.

For purposes of comparison consider the case, discussed by Wiener, of signals disturbed by noise due to Brownian movements. When the differences between the various signals are very large as compared with the average noise, then—except on rare occasions when the instantaneous noise is very much greater than its average—the presence of the noise may be ignored. The present of the system, to the degree of accuracy in which we are interested, then appears to be completely determined by the past as represented by the signals sent. If now we reduce the signals to a size comparable with the Brownian motions, this is no longer true. As stated in the first quotation, the basic assumptions of Gibbs still hold, that were the actual values of all the positions and momenta included, the present would be uniquely determined. Statistical uncertainties arise only because we choose to ignore the values of certain quantities, the existence of which we recognize. As a result the changes to be expected are at all times subject to statistical prediction only.

Contrast with this the behavior of an ensemble which includes a large number of oscillators the startings and stoppings of which are caused by disturbances which are extremely small as compared with the oscillations. A watch with some dust in its works would be started or stopped by a very small displacement of a dust particle. Once started or stopped its behavior would appear to be independent of the exact position of the particle. Suppose now we observe a large rackful of such watches under such quiet conditions that no dust particles move sufficiently to cause any watch to undergo a transition from one state of oscillation to another. They all appear to function as Newtonian systems in which all motions are accounted for and the present is completely determined by the past.

Now let the rack be loaded on a truck and driven over a moderately rough road so that the dust particles are agitated. The various watches will then be found to start and stop in an erratic fashion. The system is still Newtonian, however, and if we choose to ignore the positions and momenta of the various parts of the truck and of the dust particles, it should still be possible in theory to formulate a Gibbsian statistical treatment of the behavior of the recognized coordinates and momenta—namely, those of the watches.

Comparing this situation with that of the Brownian noise, we find an important difference. In the latter case the quantities, the values of which are ignored, produce an appreciable change in the time function of the signal at all times. In the case of the watches, however, their behavior is essentially independent of the motions of the dust particles except at widely spaced intervals of extremely short length when the transitions occur. This suggests that it should be possible to construct a statistical treatment of the behavior of the watches in which we not only ignore the values of the positions and momenta of the dust particles but also ignore their existence during those periods when they do not influence the watches appreciably. The result is a system in which each watch conforms to Newtonian laws between transitions and the times of transitions are indeterminate except that as a whole they conform to some statistical law. In setting up this system we have, for the time functions of each dust particle, broken what Wiener calls its "determinate thread of development in time." The present of the system is no longer determined by its past, and the new statistical description does not conform to the basic requirements of Gibbs.

We are thus led to the conclusion that in Newtonian systems which involve transitions of oscillators between oscillating and nonoscillating states, it may be more convenient to describe certain features of the system's behavior statistically in terms of a system which is not of the Gibbsian type than of one that is. It follows from this that the mere fact that a system involving such transitions can be conveniently described in terms of non-Gibbsian statistics does not constitute evidence that the system is not Newtonian.

So far we have assumed that the required disturbances are all very small. What happens when some or all of the oscillators are relatively stable, in the sense that they require a considerable disturbance to produce a transition? It might appear at first sight that if these are to be affected at all, the disturbance must be so large that it cannot be neglected between transitions. This is not the case, however, if the disturbance is of a random nature. Its average value may then be small enough to be neglected between transitions, and yet it will on occasion take on values great enough to start any particular oscillator. The probability of such a transition will of course decrease very rapidly as the required disturbance increases. It may still be possible, therefore, to ignore the random disturbances except as they affect the transitions.

Before taking up the parallel between this situation and that which exists in wave mechanics, attention should be called to a type of Newtonian oscillator (*1*, *2*) which has received relatively little consideration, but which is suggestive of the transitions of atomic theory. A system involving a nonlinear stiffness or inertia may "go into permanent oscillation," in which energy from an alternating source is converted into oscillations at two lower frequencies which are connected to that of the source by the usual quantum relations. For a nonlinear stiffness, the energy divides in the ratio of the frequencies. If we think of an excited state of an atom as the source, and the ground state and emitted radiation as the two oscilla-

tions which appear when the system goes into oscillation, the parallel is evident. Here, as for the familiar oscillator, a threshold condition exists, and once it is satisfied the starting of the new oscillations, and their phases, are dependent on some disturbance, however small.

If, then, it were found possible to describe atomic transitions as the initiations of oscillations of this type in a Newtonian system, the associated disturbances might produce significant effects only at the transitions. Their effect could then be adequately taken into account by assigning probabilities to the transitions and treating the system as non-Newtonian. (This of course leaves open the question as to whether the behavior of the system between transitions can be described in Newtonian terms.)

Recently, however, it has been found desirable to assume the existence of a randomly fluctuating electromagnetic field in free space, of such magnitude as to produce a small but not negligible effect on the behavior of the elementary particles. Such a field would be precisely what was assumed in the previous paragraph, and should provide a mechanism for controlling the apparently random transitions.

We arrive then at the conclusion that the fact that it has been found convenient to describe atomic phenomena in terms of a non-Newtonian system characterized by certain probabilities of transitions does not in itself constitute evidence that the system in its detailed behavior does not conform to Newtonian laws.

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An Analysis of Multiple Counter Technique for the Measurement of Radioactive Sources Independent of Geometry

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This discussion is concerned with the mathematics of a system of multiple Geiger-Müller counters for the measurement of radiations from a point source within the area bounded by the counters. Graphs are presented from which an area giving any desired accuracy of measurement can be determined.

Similar multiple counter techniques (*1, 2*) have been used by others over the past several years and offer considerable promise for precise physical, medical, and biological measurement.

A sketch of the apparatus is given in Fig. 1.

For the purpose of analysis the following assumptions are made regarding the geometry, source, and counters.

[1] The authors wish to acknowledge the counsel, during discussions, of Dr. A. K. Solomon, Biophysics Laboratory, Harvard Medical School. They also wish to acknowledge the work of P. J. Edwards, who performed the computations.

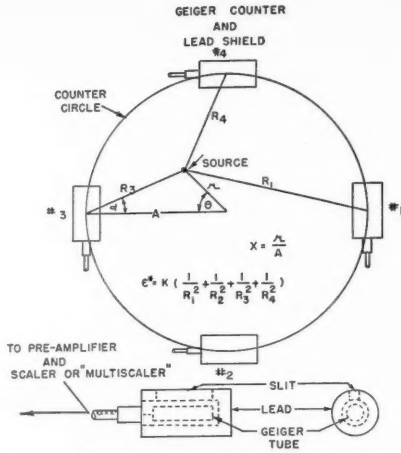


FIG. 1. Sketch of multicounter and lead shield.

1. The radiation is emitted uniformly in all directions about the source. There is no absorption in the medium between the source and counters; or the absorption is uniform in all directions.

2. The efficiency of the counter is proportional to the solid angle subtended at the source by the Geiger counter cathode, and the solid angle is inversely proportional to R^2, where R is the distance from the source to the center of the counter cathode.

3. The efficiency of the counter is independent of angle α between the normal to the counter cathode and the line from the source to the center of the cathode.

4. All counters have identical counting characteristics (plateau and efficiency).

5. The source is a point.

6. The region of interest is limited to the plane containing the centers of the four counters.

Under these assumptions the analysis is reduced to eval-

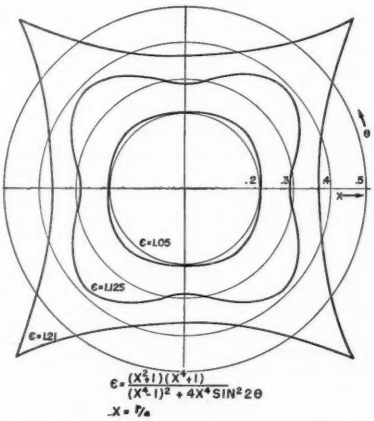


FIG. 2. Efficiency contours: x versus θ for constant ϵ (theoretical).

uating the sum of $1/R^2$ factors over all four counters for a source position within the circle passing through the four counters. This yields the following expression for the counting efficiency ε^*:

$$\varepsilon^* = \frac{K(x^2+1)(x^4+1)}{(x^4-1)^2+4x^4\sin^2(2\theta)} \qquad (1)$$

where

$$x = \frac{\mu}{A} = \frac{\text{Distance of source from center of counter circle}}{\text{Radius of counter circle}}$$

and K = a constant of proportionality containing such factors as the solid angle subtended at the center by the counters, and the energies of the gamma radiation emitted by the isotopes being measured. By considering the relative efficiency ε (compared to the efficiency ε_0 at the center of the counter circle), the constant K can be eliminated and the following expression results:

$$\varepsilon = \frac{\varepsilon^*}{\varepsilon_0} = \frac{(x^2+1)(x^4+1)}{(x^4-1)^2+4x^4\sin^2(2\theta)} \qquad (2)$$

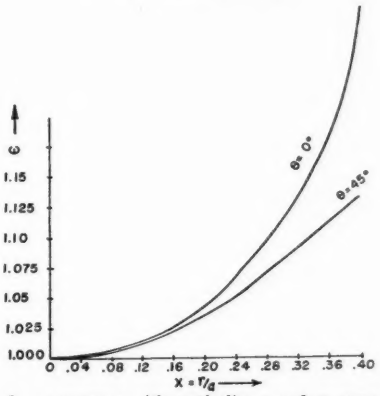


FIG. 3. ε versus x (theoretical); ε and x same as of Figs. 2 and 4.

Solution of equation (2) for x as a function of θ at constant values of ε yields the curves shown in Fig. 2. For $\varepsilon = 1.05$, i.e., for an efficiency 5% greater than the efficiency at the center of the counter circle, the curve is approximately a circle of radius very nearly one-fifth the radius of the counter circle ($x = 0.2$). Curves for higher efficiency are also given and are seen to lie outside the curve for $\varepsilon = 1.05$. Thus, within this latter curve the efficiency is nowhere greater than 5% higher than the efficiency at the center.

In Fig. 3 are shown curves of ε as a function of x at two values of θ (0° and 45°). The curve of $\theta = 0°$ (directly at one of the counters) is seen to rise much more rapidly than the curve for $\theta = 45°$ (halfway between two counters).

In Fig. 4 are shown curves of ε as a function of θ for several values of x. These curves quite describe the apparatus as defined or limited by the assumptions made above.

With regard to the variations of ε, it is of value to note that these are all positive and that the variation over a

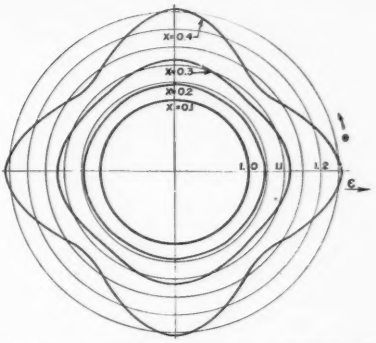


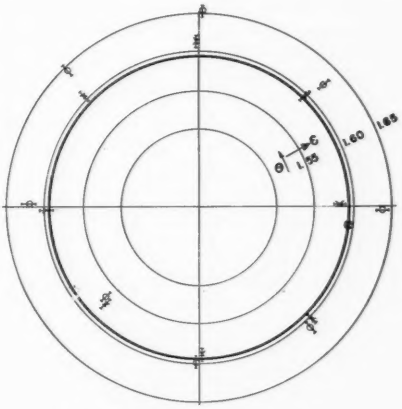
FIG. 4. ε versus θ (theoretical); ε = relative efficiency compared to efficiency at center.

distributed source is therefore generally less than that indicated by the smallest curve of Fig. 2 or Fig. 4 that fully contains the source.

Also, one should note that assumption 3 listed above is probably not fully justified when accurate measurements are being made. Consideration of the variation of ε with α, for the type of counters and shielding used, indicates that considerably smaller variations of ε may be expected than those indicated by the above analysis.

For the accuracy desired (better than 5%) it is also essential to make corrections for the counting losses incurred by the "dead time" of the Geiger counters when the counting rates are greater than a few thousand per minute. Note, however, that these losses are smaller by a factor of 4 at any given counting rate because of the use of four Geiger counters.

An apparatus described by the analysis above was assembled, an da series of measurements were made to de-



⊙= ε_0= CENTER EFFICIENCY = $1.593_4 \pm 0.003_3$
⊹= EFFICIENCY AT X=0.1; AVE.= $1.595_7 \pm 0.001_6$
◇= EFFICIENCY AT X=0.2; AVE.= $1.619_8 \pm 0.001_6$
Δ= 1.619 − 1.593 = .026 ± .004 ≃ 1.6%

FIG. 5. ε versus θ (experimental).

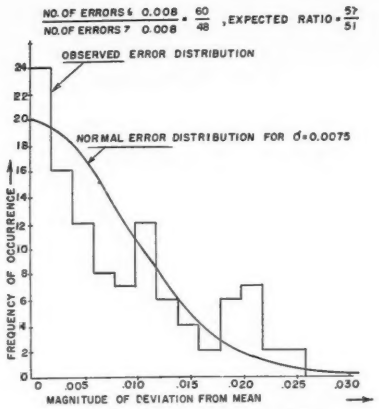


FIG. 6. Statistical summary of data.

termine its usefulness. A radium source was used and the counting rate, i.e., the efficiency in arbitrary units, was measured at the center of the counter circle and at several values of θ for each of two values of x. The results are shown plotted in Fig. 5, with arbitrary units for the ε scale. The bold circle drawn in indicates the value of ε_0 at the center of the counter circle, and it is seen that no value of ε differs from this center value by as much as 5%, indicating the validity of the analysis. Also, the average value of ε over all the measurements taken at the greatest value of x (0.2) is less than 2% greater than the center value, and the average value of ε over the smaller value of x (0.1) is practically the same as the center value, i.e., within the probable statistical error of the measurements. These averages are more significantly related to the measurements of distributed sources than are the single measurements made at particular values of θ. That these averages are appreciably smaller than the 5% that might have been expected is probably due to the variation of ε with α. This, by assumption 3 above, is assumed to be insignificant. At large values of x this variation is further increased by the thick lead shield whose slit exposes the counter to the source in a variable manner as x varies.

The probable statistical error of the measurements is considerably smaller than the observed variations. The asymmetry observed in Fig. 5 is almost certainly owing to the fact that one of the counters in this run of measurements does not have the same characteristic as the other three and therefore is counting at a higher rate. Fig. 6 shows the summary of a statistical analysis of the data, and it can be seen that the distribution of the statistical deviations of the measurements is in reasonable agreement with a normal error curve, as taken from the *Handbook of Chemistry and Physics* (30th Edition, pages 203–208).

It is expected that with this apparatus measurements of radiation dosage can be made to an accuracy approaching a few percent, subject to variations of absorption that may occur from one (human) sample to the next. We are attempting to determine the uncertainty to be expected from the greater absorption presented by the patient's neck to the counters behind the neck. Since the body is mostly matter of low atomic number, we expect the absorption will be low and very probably negligible for clinical purposes. We are also investigating the magnitude of the variation of ε with height of source above or below the plane of the four counters.

In a subsequent communication we plan to report upon this latter aspect and upon the clinical appraisals of the apparatus herein described.

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Isolation of a Steroid Hormone from the Adrenal-Vein Blood of Dogs[1]

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Lipid soluble material which protects adrenalectomized animals against cold has been demonstrated by Vogt (*5*) in blood obtained by cannulation of the adrenal vein of dogs. From the same source Paschkis *et al.* (*3*) have also found material causing liver glycogen deposition. As is well known, various active steroids have been isolated from adrenal tissue (*4*). According to the recent work of Haines *et al.* (*1*), the most abundant of these in fresh adrenal tissue is 17-hydroxycorticosterone (Kendall's compound F). The actual compound or compounds excreted by the adrenal cortex when stimulated by the pituitary adrenocorticotropic hormone have not, however, been identified. The development of a quantitative technique for estimation of cortical steroids in adrenal-vein blood (*6*) enabled us to isolate a steroid from this source.

The left adrenal vein of heparinized dogs, anesthetized with nembutal, was cannulated. The dogs were then injected with Armour's ACTH[2] and blood was collected at intervals for 2–4 hr. In some cases a second injection of ACTH was then given and the collection of blood continued as before.

The blood was diluted with an equal volume of water and extracted four times with an equal volume of ethyl ether or chloroform. These extracts were evaporated to dryness, taken up in 70% ethanol, and extracted three times with hexane. The ethanol fraction was dried, dissolved in chloroform, and chromatographed on a magnesium silicate-celite column, using progressively increasing concentrations of ethanol in chloroform. A small

[1] This study was supported by grants from the National Cancer Institute, U. S. Public Health Service; the American Cancer Society; and Ciba Pharmaceutical Products, Inc.

[2] The ACTH was supplied through the courtesy of Dr. Edwin E. Hays and Dr. F. R. Mote of Armour and Company.

amount of material having an absorption band at 240 mμ wavelength was found in some 2% ethanol fractions. This absorption band is characteristic of steroids containing the α–ß unsaturated ketone structure. Definitely separated from this was a much larger amount of material giving this absorption which appeared in the late 4% and early 6% ethanol fractions. On oxidation with periodic acid this material yielded formaldehyde (*2*).

The last two fractions mentioned were accumulated from several dogs. The crude material was acetylated and sublimed in high vacuum at 180° C. Most of the material sublimed. The sublimate was chromatographed on aluminum oxide. Material giving the 240 mμ absorption appeared in the benzene-ether fractions. On crystallization from ether pentane, the mp of the compound was 212°–220° C (corrected).[3] A sample of compound F acetate obtained through the courtesy of Dr. Harold Mason of the Mayo Clinic gave 214°–220.5° C mp (corrected). A mixture of the two compounds gave the same value, 214°–220° C. On the other hand, a mixture of the unknown with a known sample of cortisone acetate (mp 227°–236° C) gave a significant depression (mp 197°–209° C).

Chloroform solutions of both the unknown acetate and the sample from Dr. Mason gave infrared spectra indicating an α–ß unsaturated ketone, a keto group on carbons 11 and/or 20, an alcohol group, and an acetoxy group. The absorption of chloroform in the fingerprint region was so great, however, that positive identification from this region could not be made. The compound was too insoluble in carbon disulfide to give a spectrum. Attempts to obtain a satisfactory dry film with the small amount of material which remained were unsuccessful and must await accumulation of more substance.

When treated with chromic acid the acetate underwent oxidation and a compound was isolated which became opaque at 70°–100° C and melted at 220°–229° C (corrected). The small amount of material did not permit further purification. A known sample of compound E acetate showed opacity in the same range and melted at 227°–236° C (corrected).

The solubilities and region of elution from both magnesium silicate and aluminum hydroxide indicate a highly oxygenated polar steroid. The ultraviolet absorption spectrum and the formation of formaldehyde on oxidation with periodic acid place the compound among those having an α–ß unsaturated ketonic group in ring A, and a ketol side chain similar to the active adrenal steroids. The infrared spectrum confirms the presence of these groups and indicates at least two alcohol groups, one of which was easily acetylated. The mp of the acetate is similar to that of 17-hydroxycorticosterone acetate, is not depressed when the acetate is mixed with a known sample of this compound, and rises on oxidation with chromic acid toward that corresponding to cortisone acetate. The compound isolated from the blood flowing from the adrenal veins of dogs, therefore, appears to be 17-hydroxycorticosterone.

[3] Melting points were determined on the Kofler micro hot stage and measured from first softening to complete liquefaction.

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The Effect of 2,4-Dichlorophenoxy Acetic Acid and Various Other Substances upon the Respiration of Blue Lupine Seedling Roots

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The outstanding capacity of 2,4-D, the synthetic plant hormone, to control certain phases of plant growth has been known for a number of years (*3*). Concurrent with growth and exerting some regulating influence upon it is the process of respiration. In this study, the process of respiration as affected by a synthetic hormone, 2,4-D, is considered from the over-all viewpoint of oxygen uptake and carbon dioxide release, as shown in the respiration of excised seedling roots.

Materials and methods. Selected seeds of *Lupinus angustifolius* L., first treated with a wetting agent (Teel), then sterilized in a 0.25% formaldehyde solution, were germinated in sterile Petri dishes on moist filter paper at a temperature of 22° C. About three days were required for germination of roots of desirable size, namely, 3 cm, giving a dry weight of approximately 5 mg. Two to three were used per flask, suspended in 0.1 M KH_2PO_4. The experimental procedure was that of the conventional Direct Method of Warburg.

Experimental results. The effect of 2,4-D upon the respiratory rates of blue lupine. In setting up this experiment, it was assumed that 2,4-D exerts a specific inhibitory effect upon plant cells. The concentration of 2,4-D necessary to bring about an inhibition of oxygen uptake was determined over a range from 0.05 to 0.00001 M. A concentration of 0.05 M is inhibitory at both pH 4.5 and 5.0 (29% and 27% respectively), whereas at 0.01 M the inhibition is slow and gradual, although obvious (20% and 17%). Below 0.001 M (15%) significant inhibitory effect was absent. Auxin (IAA) at a concentration of 0.0016 M showed neither an inhibition nor an acceleration at pH 5.0.

The effect of substrates at a concentration of 0.01 M upon the respiration of 2,4-D-treated and untreated roots. Various compounds and substrates associated with plant metabolism were used in an attempt to overcome inhibition by 2,4-D (0.05 M) and thus give some clue as to wherein the mechanism might be located. These sub-

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TABLE 1

COMPARISON OF THE REACTION IN OXYGEN OF ASCORBIC ACID AT 0.001 M *in Vitro* AND *in Vivo*

Treatment	O_2 uptake in mm³* during period of:					
	10 min	20 min	30 min	40 min	50 min	60 min
(1) Ascorbic acid (*in vitro*)	1(1)	1(0)	1(0)†	29(28)	35(6)	38(3)
(2) Ascorbic acid in N_2 (*in vitro*)	1(1)†	0(−1)	3(3)	3(0)	.....	.....
(3) Ascorbic acid + roots (*in vivo*)	(a)14(14)	26(12)	37(11)†	65(28)	80(15)	92(12)
	(b)19(19)	39(20)	59(20)†	95(36)	122(27)	.....
(4) 2,4-D‡ + ascorbic acid (*in vitro*)	1(1)	2(1)	2(0)†	21(19)	32(11)	38(6)
(5) 2,4-D‡ + ascorbic acid + roots (*in vivo*)	5(5)	6(1)	9(3)†	17(8)	21(4)	26(5)
(6) 2,4-D‡ + roots	5(5)	9(4)	12(3)	16(4)	18(2)	20(2)
(7) Ascorbic acid§ + glutathionine‡ (*in vitro*)	1(1)†	2(1)	3(1)	3(0)	.....	.....
(8) Ascorbic acid§ + glutathione‡ in N_2 (*in vitro*)	0(0)†	1(1)	1(0)	0(−1)	.....	.....

* Figures in parentheses are the increase of O_2 uptake for a 10-min interval.
† Substance was added to flask from side arm at the end of this interval.
‡ Substance added at the beginning of the experiment. § Ascorbic acid added at end of 10-min interval.

stances included glucose; sucrose; glycine; glycollic,[3] succinic, fumaric, lactic, citric, and pyruvic acids; glutathione; ascorbic acid; and indoleacetic acid (0.0016 M). Essentially only one compound showed any indication of overcoming the inhibition of 2,4-D. This was in the case of ascorbic acid, where an increase was pronounced. But since it is generally believed that ascorbic acid is easily oxidized in an oxygen atmosphere, runs with ascorbic acid were made *in vitro* as well as *in vivo* (i.e., in the presence of roots) to determine whether the accelerated uptake was due entirely or partly to processes in the root, or to the spontaneous reaction of ascorbic acid in oxygen.[4] Experiments were carried out with ascorbic acid alone and in the presence of 2,4-D or glutathione. (Previous experiments revealed that glutathione in the presence of roots was noninhibitory.) Experiments *in vitro* and *in vivo* were conducted simultaneously, using similar reaction mixtures. The results may be found in Table 1.

These data show that when ascorbic acid alone (*in vitro*) is present (after tipping) in an atmosphere of pure oxygen, oxidation seemingly takes place completely and irreversibly over a period of 20 to 30 min. When the same conditions prevail in the presence of roots, a somewhat similar response is obtained. However, from these two experiments (Table 1, No. 3) one can, upon close scrutiny of the data, observe that in the presence of roots ascorbic acid either (1) causes a depression in the normal respiration, or (2) is itself utilized only partly (50%–70%), apparently being inhibited by some substance or mechanism in the roots. This statement is based on the fact that these normal roots, which respire linearly over a 60-min period, do show a dropping off in rate after addition of ascorbic acid.[5]

A second striking fact is noted when one compares the effects of (1) 2,4-D on roots alone, (2) 2,4-D in the presence of ascorbic acid alone, and (3) 2,4-D in the presence of ascorbic acid and roots. The 2,4-D has no apparent effect on ascorbic acid alone (No. 4), but in the presence of roots and 2,4-D (No. 5) oxidation of ascorbic acid is altered. This is more revealing in light of the response of roots in the presence of 2,4-D alone (No. 6). Assuming noninhibition of the roots by ascorbic acid, the indication is that there is only about 25% oxidation of ascorbic acid, or about half as much as utilized in the presence of roots alone (No. 3).

In an attempt to relate these phenomena with the second explanation—the partial utilization of ascorbic acid—experiments were performed with glutathione (GSH) (0.01 M) and in a nitrogen atmosphere. Both sets of experiments produced expected responses and agreed with statements from the literature.[6] The effect of a complete nitrogen atmosphere (No. 2) is similar to the suppressive effect of glutathione on ascorbic acid in an oxygen atmosphere. Therefore, the reaction *in vitro* of ascorbic acid in these experiments is an oxidative one.

[3] Glycollic acid apparently gave better response than the basic medium (control), but this had no effect in overcoming the inhibition of 2,4-D.

[4] According to Weissberger and LuValle (7), auto-oxidation of L-ascorbic acid at pH 4.7 to pH 9.2 proceeds at a rapid rate even in the absence of the cupric ion.

[5] For example, case 3a at 30 min (before addition of ascorbic acid) shows 37 mm³ O_2 uptake. At 60-min normal respiration value should be 74. Since ascorbic acid *in vitro* takes up 38 mm³ O_2. (Table 1, 1 and 4) the two combined should equal 112. The value is actually 92. Assuming 74 mm³ is due to the normal respiration, then only 18 mm³ remaining (92–74) can be attributable to ascorbic acid. This, out of a potential of 38 mm³, is roughly 50% utilization. Case b is similar if calculated for the 50-min period, and shows roughly 70% utilization of ascorbic acid. These values are not to be taken as absolute, but merely as exemplary to the case in point.

[6] Harrow (3) states that the oxidation of ascorbic acid by oxygen and ascorbic acid oxidase is prevented by the addition of glutathione. Borsook *et al.* (1) indicate that if glutathione is present, it will reverse a portion of the oxidation product (dehydro AA) formed from the oxidation of ascorbic acid.

Conclusions. The results obtained seem to indicate that none of the intermediates or substrates used, with the possible exception of ascorbic acid, is concerned with an enzyme system assumed to be inhibited by 2,4-D. There appears to be abundant evidence (*3*, p. 400) that ascorbic acid is active in a wide variety of tissues, and that it is easily oxidized by both an ascorbic acid oxidase and by atmospheric oxygen. Ascorbic acid oxidase (AAO) also is apparently rather widely distributed in nature (*3*, p. 176). It might be assumed that this oxidase is present in lupine roots and acts in its normal role (as stated). The optimum pH for the reaction is 5.6 (*5*). The reaction is specific for ascorbic acid and oxygen with the formation of water. It might be further assumed that some concentration of glutathione is present in the roots also (based on experiment No. 3). If now, when 2,4-D is added, there is greater reduction in O_2 uptake, one explanation may be that 2,4-D inhibits AAO and thus the oxidation of the greater part of ascorbic acid. If there is an established ratio of GSH to AAO in the root, that normally controls the oxidation of ascorbic acid,[7] any inhibition of one would enhance the reaction of the other. In this case the inhibition would appear to be of the substance normally accelerating O_2 uptake, namely AAO. Mitchell *et al.* (*6*) have demonstrated that *p*-chlorophenoxyacetic acid preserves a relatively high vitamin C content in bean pods when applied just before harvesting, in contrast to samples not so treated (up to 76% more in treated than in untreated). Fults *et al.* (*2*) have reported that Red McClure potatoes treated with 2,4-D retain significantly more ascorbic acid (and red color) both at harvest and after 60 days' storage than the untreated samples. One can assume that oxygen alone will oxidize ascorbic acid to a lesser extent than AAO. The remaining O_2 uptake might easily be that mediated by other oxidations and respiratory systems present in the roots.

This explantion may best be described schematically in the following stepwise manner:

1. AA (reduced) $\xrightarrow[\textit{in vitro}]{O_2}$ AA (oxidized $\longrightarrow$
   (L-AA) (dehydro AA)
   irreversible "X" products

2. AA (reduced) $\xrightarrow[\text{GSH}]{O_2}$ no reaction (*in vitro*)

3. AA (reduced) $\xrightarrow[\text{AA oxidase}]{O_2}$ AA (oxidized) + H_2O
   $\uparrow$ (−2H) $\downarrow$
   GSH
   (*in vivo*) (possible assumption—see footnote 7)

4. AA (reduced) $\xrightarrow[\text{AA oxidase}\ +\ \text{2,4-D}]{O_2}$ no reaction (*in vivo*)

According to experiments on growth with both higher plants (*4*) and microorganisms (*8*), it was concluded that oxygen was rendered unavailable to the organism by the action of 2,4-D. It was further concluded that the growth in the presence of 2,4-D was similar to growth of anaerobic organisms. This evidence indicates that 2,4-D inhibits an oxidase and that the balance of the respiration is carried on by some "extra-2,4-D" system not involving this particular oxidase. It is also believed that an oxidase system is similarly involved in the respiratory inhibition of blue lupine roots by 2,4-D.

Further experimentation is necessary to elucidate these contentions in relation to the specific oxidase and possibly to a dehydrogenase system (or systems) involved.[8] From indirect evidence presented, involving several intermediates generally related to dehydrogenase stems (malic and succinic), one might surmise that the normal scheme of Krebs, if indeed it is present at all, is not the one involved in the response of blue lupine roots to 2,4-D.

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[7] The following scheme for interaction of L-AA and glutathione in oxidation-reduction reactions in biological systems is a rather widely accepted one:

$$\text{L-AA} \xrightarrow[\text{AAO}]{\substack{\xleftarrow{\text{GSH (reductase)}} \\ (+2\text{H}) \\ (-2\text{H})}} \text{dehydro AA.}$$

[8] In two subsequent experiments, malonate (0.01 M) and iodoacetate (0.001 and 0.0001 M) produced no inhibitory response whatsoever. Iodoacetate and 2,4-D, both at 0.01 M, gave somewhat similar inhibitory responses. Further screening experiments involving adenosine triphosphate, hexosediphosphate, coenzyme 1, cytochrome C, and onion juice revealed no apparent correlative evidence.

Comments and Communications

Prosodic Patterns and Oral Stress

W. F. Dearborn, P. W. Johnston, and L. Carmichael, in their comments on "Oral Stress and Meaning in Printed Material" (*Science*, 1949, **110**, 404) are talking about matters in a highly specialized and technical field of science of whose existence they seem to be completely unaware. The analysis of the cultural behavior known as language, and of specific languages, has been going on for some time in various places, and there exist in the world some dozens at least of persons who devote themselves to the science of linguistics—a branch of anthropology. These linguists (a technical use of the term, not to be confused with the layman's use of it to mean one who speaks many languages—a polyglot) have long proclaimed the basic fact that language is "the noises you make with your face," not the marks you make on paper with pen and ink. What is called "written language" is only a very limited and pale reflection of linguistic behavior. A language is understood only as it is spoken and heard; reading a printed page necessarily means converting the symbols into the sounds they stand for. All existing orthographies are rather inadequate. English is especially bad in some ways, but all of them are equally defective in failing to represent to any great degree those large and important parts of utterances that the linguist analyzes as prosodic patterns—those of stress, juncture, and intonation (these are all technical terms, and cover what Dearborn *et al.* probably mean by "oral stress").

It is therefore not surprising, nor is it any new discovery, that those persons who cannot recognize the prosodic patterns of a printed passage are unable to understand it. These patterns are just as much part of the language as are the vowels and consonants represented by the printed letters.

The suggestion that ways be found in printing to bring out the prosodic patterns is well taken. But it must be understood that this cannot be done merely by supplying a few italic or boldface characters, nor can it be done by those who are completely unaware of what is known about linguistic structure and analyses. It is most unfortunate that many workers in psychology and related fields are not acquainted with the pertinent findings of other social sciences, and especially of linguistics, and are therefore unable to take advantage of knowledge already systematized which could help them in setting up their researches and in avoiding the performance of activities whose results are vitiated by lack of a suitable frame of reference.

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The recent communication from Dearborn and others on oral stress and meaning in printed matter gives a welcome reminder of the close relation between those qualities. But I do not believe that there is need of indicating oral stress by new typographical devices, for countless degrees of emphasis can be conveyed in ordinary roman type by means of structure and punctuation.

Good structure, brought out by intelligent punctuation, results in a quality that may be called good cadence. Cadence is best put to the proof by reading aloud; prose may be said to have good cadence if, when it is read aloud at sight, the oral stresses tend to fall automatically on the more significant words. Most of those words ought to be placed at or near the ends of clauses, sentences, and paragraphs, where a large proportion of them will be closely followed by punctuation marks. When significant words or word groups are so placed, they not only are stressed in reading aloud but readily catch the eye, so that they seize the attention not only of auditory but of visual readers. If the accents are well distributed, at intervals that are varied and rarely very short or very wide, the cadence will afford pleasure to those who mentally hear what they read; but good cadence is not a merely ornamental quality: it helps make printed matter understandable for visual and auditory readers alike.

While cadence depends primarily on arrangement of words, it would be hard to perceive in matter that had no punctuation, and is best perceived in matter that is well punctuated. Punctuation deserves more respect than it commonly receives; we are too often told that the less we have of it the better—which is no truer of punctuation than it is of food—and writers too often expect that it will be done for them by somebody else. The writer who punctuates for himself will understand the structure of his writing better than one who "lets George do it"; and punctuation, when guided by understanding of a few principles rather than by a multitude of rules learned by rote, is less difficult and more interesting than is commonly supposed. It assumes a new interest when considered in relation to cadence.

Punctuation and syntax have been the means by which, time out of mind, competent writers have been able to indicate innumerable shades of emphasis, and that is why the use of italics, except under a few special circumstances, is generally regarded as a confession of weakness. In laboratory directions and military orders it may be justifiable to employ italics more frequently than in ordinary reading matter, or even to resort to large and small capitals. These, together with conventional type, would indicate four degrees of emphasis in addition to those producible by structure and punctuation, which ought surely to be enough without adding (or substituting) the esthetically pleasing devices that Dearborn and his colleagues promise to reveal in due time. One cannot help fearing that even these will distract attention from the meaning rather than bring it out.

This distracting effect would gradually wear off if the scheme were widely accepted; but I do not think it ever will be, because it is unnecessary for the reasons I have tried to indicate. If it won universal acceptance, it would oblige the printers to invest great sums in new fonts of type. Its probable effects on our habits of writ-

ing and reading seem rather terrifying to the conservative mind; if people wishing to express ideas in print became accustomed to leaning on these typographical crutches, they would not bother to learn how to write, and those who looked at nothing but current publications would forget how to read. Literary English might then become a dead language.

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The Use as Test Material of Inbred Strains of Mice Having High Frequencies of Audiogenic Seizures

As a result of Hall's discovery of a strain of mice which showed a high and predictable frequency of audiogenic seizures, the idea has been advanced by several workers that these animals may be used as convenient test material for analyzing the results of a large number of psychological, pharmacological, hormonal, and nutritional factors which may affect the nervous system.

At a recent informal conference of workers on audiogenic seizures at the Jackson Laboratory it was suggested that it would be desirable to summarize the basic information necessary for new workers in the field, so that results comparable to those of other workers may be obtained, and so that ineffective techniques may be avoided. It was also agreed that the Division of Behavior Studies at the Jackson Laboratory would, for the present, act as a center for exchange of information between workers, with the cooperation of C. S. Hall of Western Reserve University, and Benson Ginsburg of the University of Chicago.

Three essential factors concerning seizures in mice need to be kept in mind:

1. The bell-tub technique of Hall appears to be adequate to elicit the phenomenon. A 2½-in. doorbell run by two or three No. 6 dry cells or a bell transformer, hung over the edge of an ordinary 14-gal. galvanized wash-tub is rung for 2 min. If seizures occur, they usually appear in less than 60 sec. It has been conventional to record at least the following variable aspects of behavior: a) preconvulsive behavior, b) latency of convulsion, c) type of convulsion, d) survival or nonsurvival.

2. It has been conventional to test animals at 30 days of age (which appears to be close to the time of maximum frequency in the dba[2] strains), and to repeat tests on survivors daily thereafter for a total of four or five tests. In the dba strains the phenomenon disappears almost entirely after 45 days of age.

3. Subline differences appear to be extremely important. Care should be taken that the animals used come from an inbred stock, tracing back through a single line of brother-sister mating as pedigreed by known workers. At the present time the following strains are known to produce high frequencies: Dilute Brown subline 1 (dba[1]) (Little, Murray, Fekete, Hall), and Dilute Brown subline 2 (dba) (Little, Woolley, Vicari). The C57 Black strains, subline 6 (Little, Fekete, Hall), and subline 10 (Little, Russell, Scott), are known to give very low frequencies of seizures. All these strains are carried at the Jackson Laboratory at the present time and can be made available to workers at other institutions.

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News and Notes

ONR Conference on Physics and Chemistry at High Temperatures

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A conference on physics and chemistry at high temperatures was held at the Research Institute of Temple University in Philadelphia on April 25. Sponsored by the Office of Naval Research, Department of the Navy, the conference was arranged to bring together those engaged in high temperature research under ONR and related contracts. It was attended by 80 invited guests and participants representing government agencies, universities, and industrial concerns interested in high temperature research. The technical program included papers on the production and measurement of high temperatures and the reactions of gases, metals, and ceramics under these extreme conditions.

The operation of a solar furnace was described by William M. Conn of Rockhurst College, Kansas City, Missouri. Radiant energy from the sun is concentrated in this furnace by a parabolic mirror in a sample placed near the focal area of the mirror. This method is limited to a small heating area but it produces rapid, controlled heating without electrical interference. When the sample is enclosed in a suitable quartz container experiments may be carried out in various types of atmosphere and under pressure limited only by the breaking point of the quartz. Dr. Conn has reached temperatures of 3000° C in this type of furnace equipped with an aluminum mirror 120 in. in diam and 34 in. in focal length.

The production of high temperatures by the combustion of metals was reported by Aristid V. Grosse, of the Research Institute of Temple University. The temperature is obtained by burning metals with oxygen under either atmospheric conditions or pressures up to 300 psi. When metals that have a high exothermic heat of reaction and simultaneously form highly refractory oxides are used, the heat liberated is concentrated close to the reaction zone to produce the high temperature. Aluminum, calcium, magnesium, titanium, and zirconium have been burned successfully under atmospheric conditions. The aluminum reaction produces the highest temperature, which has been observed to be in the neighborhood of 2800° C. Theoretically, it should be possible to obtain a temperature of 6500° C by burning zirconium in oxygen at 100 atmospheres.

The first public demonstration of the method was made following presentation of this paper, when aluminum was burned with oxygen under atmospheric conditions. A special alumina furnace was charged with aluminum dust and shavings, which were easily ignited with a lighted cigarette. Aluminum rods were fed into the furnace to maintain the temperature. The interesting phenomenon of the "skating sun" was observed in the furnace. The skating sun is a brilliant body of boiling aluminum, of a flat and round shape, burning in oxygen and skating on the surface of molten alumina.

Oxidation studies on "cermets" at high temperatures were reported by W. B. Crandall, of Alfred University. Cermets are mixtures of refractory oxides and metals in which the metal component is added for strength and the ceramic component is used for its refractory properties. The systems studied included binary mixtures of CO, Ni, Fe, Al, and Be with Al_2O_3BeO, MgO, ZnO_2. Dr. Crandall suggested that the oxidation behavior may be explained by considering the rate at which oxygen diffuses into the physical system and by the rate at which oxygen is removed from the pores by oxidation of the metal. It was indicated that there may be applications for these materials in high temperature-high stress work if the oxidation rates of the metal components can be controlled.

Tantalum silicides were offered as promising new ceramic materials by Leo Brewer, of the Radiation Laboratory of the University of California, who reported the investigation of a number of borides, carbides, silicides, and sulfides. Cesium and thorium sulfides, tantalum, titanium, and zirconium carbides, and cesium and tantalum borides were reported as being resistant to electropositive metals at temperatures above 2000° C.

Dr. Brewer also reported on the constitution of the saturated vapor over a number of oxides at high temperatures. He has found that many refractory oxides vaporize by decomposition to the elements. Thus in the case of MgO, CaO, ZnO, CdO, HiO, FeO, MnO, and probably most of the alkali oxides except Li_2O, the agreement between observed and calculated volatilities indicated that the undecomposed diatomic molecules are not important in the vapor.

Three papers were presented covering work being done at the Cryogenic Laboratory, Ohio State University. Herrick L. Johnston discussed the high temperature properties of tantalum and described a drop calorimeter, a high temperature x-ray camera, and vapor pressure cells that employ either the Zangmuir or the Knudsen method. Using this equipment, data have been obtained up to about 2200° C. In a second paper, Dr. Johnston described an apparatus similar in design to a precision vacuum calorimeter, which was developed to measure gaseous pressure-volume-temperature data at low temperatures. Using this apparatus, gaseous data of state for hydrogen have been obtained. Approximately 30 PV isotherms have

been determined for hydrogen at temperatures between 20° and 350° K for pressures up to 200 atmospheres and the results have been used to calculate the second and third virial coefficients.

In the third paper, Rudolph Speiser discussed the role of surface adsorption in physical metallurgy at high temperatures. Dr. Speiser reported that by the application of surface thermodynamics it is possible to predict the circumstances under which the solute in a binary alloy is concentrated or deflected in the grain boundary.

The existing experimental and theoretical data on the specific heats of gases at temperatures above 1000° C were reviewed by W. S. Benedict, of the National Bureau of Standards. He discussed the precision of experimental results and the limitations of theoretical specific heats connected with dissociation and relaxation phenomena.

A review of the measurements of flame temperatures was presented by H. P. Broida, of the National Bureau of Standards. It included the problems which have been and will be encountered in these measurements and conjecture on the direction of future research in this field.

The measurement of temperatures up to 2000° C by a method termed noise thermometry was described by A. W. Lawson, of the University of Chicago. Employing the principle that the root mean square of the radiofrequency generated by thermal agitation in resistors varies with the temperature, the method compares noise from a known cold source with that from the unknown hot source through a null circuit with an accuracy of 0.1 percent. Experiments indicate that noise thermometry should be capable of competing with other laboratory absolute temperature scales at high temperatures and pressures.

The conference was opened by an address of welcome by Robert L. Johnson, president of Temple University, and an introduction by Alan T. Waterman, chief scientist of the Office of Naval Research. Aristid V. Grosse, president of the Research Institute, presided at the morning session and A. Michels, of Van der Waals Laboratory, presided at the afternoon session. The leadership of Dr. Michels produced many interesting discussions which lasted into the early evening.

Conference on Interaction of Steroids and Enzymes

Charles D. Kochakian

School of Medicine and Dentistry
University of Rochester

A conference on interaction of steroids and enzymes was held March 8–10 under the sponsorship of the recently organized Ciba Foundation at its center in London, England. This conference is one of a series to be sponsored by the foundation in carrying out one phase of its program for "The Promotion of International Cooperation in Medical and Chemical Research."

In accordance with the informal purpose of these conferences, the attendance was limited to about 15 guests, of whom there were from the U. S., three from Scotland, and the remainder from England. Several guests from other countries were unable to attend. S. J. Folley, of the Institute of Dairy Research, University of Reading, England, served as chairman.

The first day of the conference was devoted to enzyme studies with respect to the reproductive functions. W. H. Fishman and G. T. Mills discussed the measurements, nature, and properties of glucuronidase. I. D. E. Storey reported that mouse tissues apparently have a different mechanism from those of the guinea pig for the synthesis of glucuronides and indicate a possible participation of carbon dioxide. Curnow and Dodds reported that only small amounts of injected synthetic estrogens or their glucuronide appear in the urine as glucoronide. Furthermore, differences among species were noted. W. H. Fishman reported some correlations of degree of glucuronidase activity with the amount of estrogen present in the organism.

R. K. Meyer correlated changes in *corpora lutea* activity under various normal and induced endocrine states with changes in alkaline and acid phosphatases, succinoxidase and malic dehydrogenase.

The second day of the conference was devoted to the relationship of enzymes to metabolic processes induced by hormones. C. D. Kochakian discussed the influence of androgens, estrogens, corticoids, growth hormone, alloxan and phlorizin diabetes, and diet on the arginase and alkaline and acid phosphatases of the liver, kidney, and intestine of various laboratory animals in relation to their effects on protein metabolism. A. L. Greenbaum described changes in arginase and alkaline phosphatase activity in the liver and mammary gland during various phases of lactation in normal and adrenalectomized rats.

W. H. Fishman, as a result of his studies and others', concluded that ß-glucuronidase is concerned with some specific process in growth which is often related to estrogen action. R. K. Meyer pointed out that the growth induced in the rodent uterus is accompanied by an increase in glucuronidase.

Elson was unable to relate the growth-inhibiting action of cancer-producing substances to hormonal regulation of protein and carbohydrate metabolism.

Raymond L. Zwemer, executive secretary of the National Academy of Sciences and of the National Research Council, has been appointed chief of the Science Division and consultant in biology of the Library of Congress. Dr. Zwemer will take over his duties as division chief July 1, and will serve as biology consultant beginning June 1.

Howard J. Shaughnessy, chief of the Division of Laboratories, Illinois Department of Public Health, has been appointed professor and head of the newly created Department of Public Health at the University of Illinois College of Medicine. Dr. Shaughnessy will divide his time between the university and the Department of Public Health, where he will continue to serve as director of laboratories.

Eugene B. Ferris, Jr., associate professor of medicine at the University of Cincinnati College of Medicine, has been elected president of the American Society for Clinical Investigation. Dr. Ferris is also editor of the society's *Journal of Clinical Investigation.*

William A. Mussen, of the U. S. Naval Ordnance Laboratory, has been appointed supervisor of the Electronics Laboratory at Southwest Research Institute, San Antonio, Texas.

William F. Harrigan succeeds the late **Leo Winter** as chairman of the Department of Oral Surgery at New York University's College of Dentistry. Dr. Harrigan is associate oral surgeon at Bellevue Hospital.

Visitors to U. S.

Gunnar Nilsson-Leissner, of Stockholm, newly appointed seed consultant of United Nations Food and Agriculture Organization, will arrive in Washington, D. C. this fall to coordinate seed supplies for all countries.

Thirteen physicists from abroad will participate in the Conference on Ionospheric Physics, to be held at Pennsylvania State College July 24–27 (see *Science,* March 17, p. 293). They are: **S. K. Mitra,** University College of Science and Technology, Calcutta, India; **L. Harang,** Norwegian Defense Research Establishment, Kjeller, Norway; **S. Chapman,** Oxford University, Oxford, England; **L. G. H. Huxley,** Adelaide University, Adelaide, South Australia; **J. Sayers,** The University, Birmingham, England; **W. Dieminger,** Institüt fur Ionospharenforschung, Lindau, Germany; **D. F. Martyn,** Australian Council for Scientific and Industrial Research, Canberra, Australia; **K. Weekes,** Cambridge University, Cambridge; **Peter M. Millman,** Dominion Observatory, Ottawa, Canada; **D. R. Bates,** University College, London; **M. Nicolet,** Department of Radiation, Royal Meteorological Institute of Belgium, Uccle; **R. v. d. R. Woolley,** Commonwealth Observatory, Canberra, Australia; and **W. R. Piggott,** directorate of radio research, Department of Scientific and Industrial Research, Slough, England.

F. A. S. Gwatkin, chairman of the Proprietary Association of Great Britain, is one of the speakers at the annual meeting of the Proprietary Association of America, being held this week at White Sulphur Springs, West Virginia.

Suzanne Leclercq, director of paleobotany at the University of Liège, arrived in New York City April 11 for a ten-week study of Devonian and Carboniferous fossil collections at U. S. universities, including Harvard, Cornell, Michigan, Chicago, Illinois, and Washington University at St. Louis.

Visiting lecturers at the Massachusetts Institute of Technology during the summer will include **P. Scherrer,** of the Eidgenoissische Technische Hochschule, Zurich, who will lecture on "Experimental Atomic Physics," and **E. Amaldi,** of the University of Rome, whose subject will be "Nuclear Physics."

Grants and Awards

The Daniel and Florence Guggenheim Jet Propulsion Center at the California Institute of Technology has granted six fellowships for 1950–51—twice the number granted last year. Recipients were Thomas C. Adamson, Jr., LeGrange, Illinois; Eldon L. Knuth, Luana, Iowa; Robert V. Meghreblian, Los Angeles; Joseph E. Padgett, Jr., Baltimore, Maryland; David E. Shonerd, Pasadena, California; and Edward E. Zukoski, Birmingham, Alabama. Mr. Meghreblian, a native of Cairo, Egypt, received the grant for the second time.

The Life Insurance Medical Research Fund has approved awards totaling $670,000 to medical schools and other research centers during 1950 for the study of heart disease and the training of research scientists. Recipients of the Lasker Award from the American Public Health Association last year for its contributions to the advancement of medical science and public health, the Life Insurance Medical Research Fund is now being supported by 147 life insurance companies of the U. S. and Canada. Fifty-one research programs will be supported by grants of $548,000 to 36 institutions. An additional $122,000 will go to 34 research fellows to help fill the deficiency in trained research workers. The largest grant, $21,000, went to Johns Hopkins University School of Medicine for research by E. K. Marshall, Jr., on the pharmacology of cinchoninic acid derivatives.

The Theodore William Richards Medal was presented on May 11 to John Gamble Kirkwood, of the California Institute of Technology, at a meeting of the Northeastern Section of the American Chemical Society. Professor Kirkwood was cited for his contributions to the development of statistical mechanics.

The Elisha Mitchell Scientific Society has awarded the **William Chambers Coker** prize for 1950 to Shantilal A. Vora for his thesis, "Bounds for the Distribution of Chi-Square" in the Department of Mathematical Statistics, University of North Carolina. The $50 prize, established two years ago, is awarded annually for a doctoral thesis in science.

Frederick D. Rossini, chief of the Thermochemistry and Hydrocarbons Section of the National Bureau of Standards, has been named to receive the **Department of Com-**

merce **Exceptional Service Award** for his contribution to the field of hydrocarbon research.

Henry C. Harris, agronomist, Florida Agricultural Experiment Station, Gainesville, Florida, has been awarded the first **Oak Ridge Research Fellowship**, and will do a year's research at the Oak Ridge Laboratory using radioactive isotopes.

The Psychophysiology Branch, Human Resources Division, Office of Naval Research announces that the following contracts have recently been made: L. L. Sloan at the Wilmer Ophthalmological Institute, Johns Hopkins University, will investigate visual depth perception; and at Brown University Carl Pfaffmann will do research in the psychophysiological factors in taste sensitivity, and Lorrin A. Riggs will carry on the study of corneal-retinal potentials.

Fellowships and Prizes

The Social Science Research Council has received a grant of $465,000 from the Carnegie Corporation to finance faculty research fellowships over a five-year period. Seven fellowships will be awarded annually. Each candidate must be under the age of 35 years, have a doctoral degree or its equivalent in one of the social sciences, be a regular faculty member in a U. S. college or university, and be nominated or endorsed by the head of his or her department. Further information may be obtained from Elbridge Sibley, Executive Associate, Social Science Research Council, 726 Jackson Place, Northwest, Washington, D. C.

Sigma Delta Epsilon announces that a second research award of $500 will be presented during the AAAS meeting in Cleveland, Ohio, in December. Members of Sigma Delta Epsilon, in good standing as of April 1, 1950, and engaged in research in the mathematical, physical, or biological sciences, are eligible. Joint papers will be accepted. The award will be given to the author or authors of the best paper describing original research, published or accepted for publication in a scientific journal during 1950, or presented at a regular session of any scientific society meeting during the year. Papers must be submitted in triplicate to the Research Awards Committee not later than *October 1*.

Another award of $200 is available for 1950 for the best paper describing original research carried out in the home. Conditions of the award will be similar to those just mentioned. For further information write Lela V. Barton, Chairman, Research Awards Committee, Boyce Thompson Institute for Plant Research, 1086 N. Broadway, Yonkers 3, New York.

The School of Medicine, Western Reserve University, has established an **Eddie Painton Fellowship in Rheumatic Fever** in the Department of Preventive Medicine and the university hospitals. One year of clinical work and one year of laboratory work, or two years of clinical training are prerequisites for the fellowship and it carries a stipend of $3,600 per year. Appointments will be made annually, but are subject to renewal. Applicants should write to Dr. John H. Dingle, Department of Preventive Medicine, School of Medicine, Western Reserve University, Cleveland 6, Ohio.

Summer Programs

Two summer courses will be offered by the University of Virginia at its **Mountain Lake Biological Station.** The first term (June 15–July 19) will include studies in morphology of seed plants, plant taxonomy, experimental morphogenesis, and acoelomate invertebrates. The second term (July 20–August 23) will include general physiology, aquatic biology, plant ecology, and morphology of the animal cell. Further information may be obtained by writing to the Registrar, Summer Session, University Station, Charlottesville, Virginia.

The third annual industrial microbiology short course will be held at Purdue University June 19–July 1, under the direction of C. L. Porter, professor of botany. The course includes a two-week program for research and production directors and technicians, and a refresher course for college teachers and research workers. Additional information may be obtained from Dr. C. L. Porter, School of Science, Purdue University, Lafayette, Indiana.

Meetings and Elections

First Symposium of the Chemical-Biological Coordination Center

More than 250 chemists and biologists are expected to meet in Washington this week for a symposium that includes a discussion of the program of the National Research Council's four-year-old Chemical-Biological Coordination Center (*Science*, March 3, p. 244).

Biological properties of chemicals are often discovered accidentally and many times have to be rediscovered when needed for a specific purpose because the original findings have received little notice. The aim of the CBCC is to make such information readily available. The need for such work—the assembling and organizing of data relating the effect of structure of chemicals upon their biological activity—was demonstrated during the war by the Insect Control Committee of the Office of Scientific Research and Development. The CBCC is carrying on that committee's work, but in a program of vastly broader objectives. Thus far the project has developed in three fields of activity: correlating material already published, sponsoring biological tests of chemical compounds, and preparing review articles on the effect of chemical structure upon various biological actions.

The center, directed by W. R. Kirner, has an executive committee and an advisory committee, both under the chairmanship of M. C. Winternitz, and subcommittees on biochemistry, chemotherapy, entomology, mammalogy, medicine, microbiology, physical chemistry, plant sciences, sanitary engineering, veterinary medicine, malignancy, organic chemistry, and physiology-pharmacology. Its scientifically trained staff of 16 persons has worked out elaborate chemical and biological codes, with the assistance of codification panels headed by C. Chester Stock, J. C. Bailar, and McKeen Cattell. By means of these

codes, data on the biological, chemical, and physical properties of compounds are recorded on punch cards and sorted by IBM machines for correlation studies.

Because many compounds have been tested for only a single purpose and many others have never been examined at all for biological activity, the CBCC solicits compounds synthesized by private investigators, institutions, and commercial laboratories. It has a roster of approved nonprofit laboratories that conduct screening experiments to determine the biological usefulness of the compounds. Data resulting from the tests are promptly reported to the person who submitted the compounds and are also critically reviewed by the center and its appropriate subcommittees and organized for further use. The center takes no responsibility, however, for publication of data on the synthesis of compounds or their biological action, or for patent applications on useful chemicals.

The proceedings of this week's symposium will be published in full. The Chemical-Biological Coordination Center is still in the experimental stage and it invites the suggestions and cooperation of chemists and biologists who cannot attend the meeting.

The 13th meeting of the Meteoritical Society will be held September 5–7, at the Museum of Northern Arizona, Flagstaff, Arizona, and at the Canyon Diablo Meteorite Crater. The scientific sessions, which will be open to the public, will begin at 9 a.m. and 2 p.m. on Tuesday and Wednesday at the Museum of Northern Arizona. The excursion to nearby Canyon Diablo Meteorite Crater is scheduled for Thursday.

The National Academy of Sciences, at its annual meeting in Washington, D. C., April 24–26, elected a new president, a foreign secretary, two additional council members, 30 academy members, and two foreign associates.

The new president is Detlev W. Bronk, president of Johns Hopkins University and chairman of the National Research Council. Dr. Bronk, who succeeds Alfred N. Richards, will serve a four-year term beginning July 1. Roger Adams, head of the Department of Chemistry, University of Illinois, and president of the AAAS, was elected foreign secretary, succeeding Dr. Bronk for a four-year term ending June 30, 1954. Oliver E. Buckley, president of Bell Telephone Laboratories, and Walter S. Hunter, chairman of the Department of Psychology at Brown University, were elected to membership on the Council of the Academy to serve until June 30, 1953.

Newly elected members are: Francis Birch, professor of geophysics, Harvard University; S. Bochner, professor of mathematics, Princeton University; James Bonner, professor of biology, California Institute of Technology; Ernst Cloos, professor of structural geology, Johns Hopkins University; Lyman C. Craig, member of Rockefeller Institute for Medical Research, New York City; Lester R. Dragstedt, chairman, Department of Surgery, University of Chicago; David R. Goddard, chairman, Department of Botany, University of Pennsylvania; Herbert S. Harned, professor of chemistry, Yale University; G. Evelyn Hutchinson, director of graduate studies in zoology, Yale University; M. R. Irwin, professor of genetics, University of Wisconsin; Edward Calvin Kendall, head of Section on Biochemistry, Mayo Clinic; Gerard P. Kuiper, professor of astronomy, Yerkes Observatory, University of Chicago; W. F. Libby, professor, Institute for Nuclear Research, University of Chicago; Fritz A. Lipmann, head of Biochemical Research Laboratory, Massachusetts General Hospital, Boston; R. Lorente de No, member of Rockefeller Institute for Medical Research, New York City; Frank C. Mann, professor of experimental medicine, Mayo Foundation, University of Minnesota; Kenneth F. Maxcy, professor of epidemiology, School of Hygiene and Public Health, Johns Hopkins University; C. E. Kenneth Mees, director and vice president in charge of research, Eastman Kodak Company; Eger Vaughan Murphree, president and director, Standard Oil Development Company, New York City; Alfred O. Nier, professor of physics, University of Minnesota; Arthur E. Raymond, vice president and director, Douglas Aircraft Company, Inc., Santa Monica, California; Bruno B. Rossi, professor of physics, Massachusetts Institute of Technology; B. F. Skinner, professor of psychology, Harvard University; J. A. Stratton, provost of Massachusetts Institute of Technology; Victor C. Twitty, chairman of Department of Zoology, Stanford University; George Wald, professor of biology, Harvard University; Howel Williams, chairman of Department of Geological Sciences, University of California, Berkeley; Ralph E. Wilson, astronomer, Mount Wilson Observatory; Oskar Wintersteiner, head of Division of Organic Chemistry, Squibb Institute for Medical Research, New Brunswick, New Jersey; M. L. Wolfrom, head of Division of Organic Chemistry, Ohio State University.

Foreign associates are: Charles Herbert Best, director of Banting and Best Department of Medical Research, University of Toronto; and Albert Jan Kluyver, professor of microbiology, Technical University of Delft, Netherlands.

Recently Received—

Handling Radioactive Wastes in the Atomic Energy Program. U. S. Atomic Energy Commission. U. S. GPO, Washington 25, D. C. 15 cents.

Possibilities for Oyster Culture in Puerto Rico and the Virgin Islands. Special Scientific Report: Fisheries No. 9. Fish and Wildlife Service, U. S. Department of Interior, Washington 25, D. C.

Methods for Microbiological and Chemical Determinations of Essential Amino Acids in Proteins and Foods. U. S. Department of Agriculture Misc. Publ. 696. U. S. GPO, Washington 25, D. C. 10 cents.

Microphthalmos and Anophthalmos With or Without Coincident Oligophrenia. Torsten Sjögren and Tage Larsson. Ejnar Munksgaard, Norregade 6, Copenhagen, Denmark.

Canadian National Research Council Review, 1949. Council on Scientific and Industrial Research, Ottawa, Canada.

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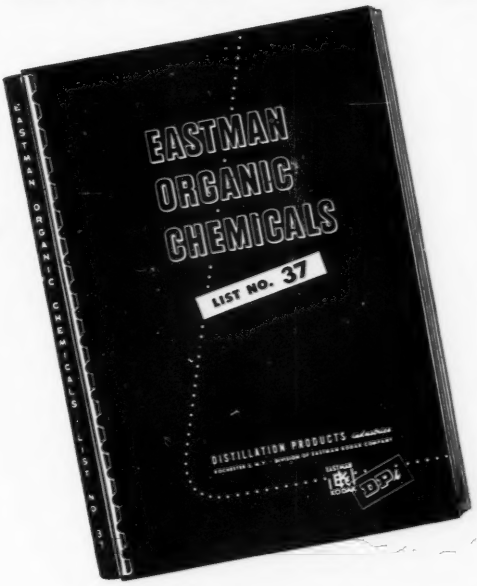

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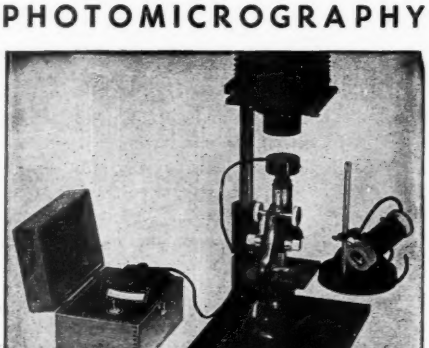

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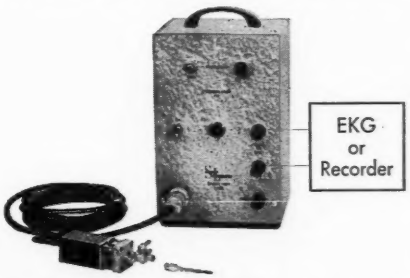

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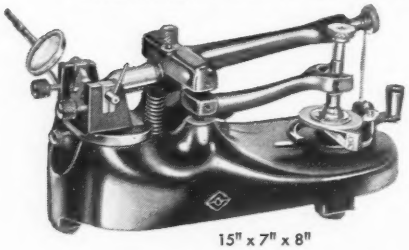

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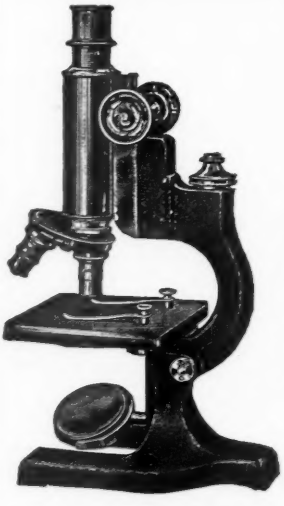
This moderately priced instrument is designed specially for cutting extremely thin sections for use with the Electron Microscope. The sections cut with this Microtome are ribboned, which makes it most convenient for studies of sections serially. Will accommodate Gillette razor blade or special Microtome knife. Fitted with magnifying lens for observing work in progress.

Write for Bulletin L 293.

CAMBRIDGE INSTRUMENT CO., INC.
3748 Grand Central Terminal, New York 17, N. Y.
PIONEER MANUFACTURERS OF PRECISION INSTRUMENTS

GUARANTEED REBUILT MICROSCOPES



MODEL CT2
Equipped with:

10X Ocular
16 mm. Objective
4 mm. Objective
Iris diaphragm
double mirror.
Coarse and fine adjustment.

Price .. ea. $72.50

Fully guaranteed and sold on 10 days approval. Other models from $45.00 with same optical equipment.

Write for catalogue. All models available.

GRAF APSCO CHICAGO U.S.A.

THE GRAF-APSCO CO.
5868 Broadway Chicago 40, Ill.

Laboratory Pre-Tested for Microbiological Uses
CASEIN HYDROLYSATES

"Vitamin Free" Casein Hydrolysate GBI
For U.S.P. and other standard assays for B-Complex vitamins, amino acids and bacterial nutrition studies.

LIQUID—acid hydrolysate (*sterilized*)
1 doz. 100 ml. bottles — $16.00.

POWDER—enzymic hydrolysate (*lyophilized*)
Each bottle of dry powder makes 100 ml. of solution. 1 doz. bottles — $17.50.

Related GBI Products
Other special microbiological media, crystalline vitamins, amino acids and miscellaneous biochemicals.

Write for Catalog No. 677

GENERAL BIOCHEMICALS, INC.
60 LABORATORY PARK CHAGRIN FALLS, OHIO
Reg. U.S. GBI Pat. Off.

a tested formula
for increasing your sales
. . . ADVERTISE in SCIENCE
Satisfied advertisers give proof that SCIENCE

- **PRODUCES SALES**

  "Science is consistently our most profitable medium. Business secured solely thru SCIENCE ads has been the backbone of our success in this field."*

  ". . . our client joins us in expressing our satisfaction at the results advertising in SCIENCE has accomplished."*

- **INCREASES INQUIRIES**

  "The ——— Chemical Company received over 80 inquiries from a ¼-page, which was far more than they expected."*

  "SCIENCE is an exceptionally fine producer of inquiries and sales for us."*

- **BUILDS DISTRIBUTION**

  ". . . we feel that our advertisements in SCIENCE have been of great value to us in making our animals known throughout the scientific world. . . . We consider it one of the best mediums for this purpose."*

* Names on Request

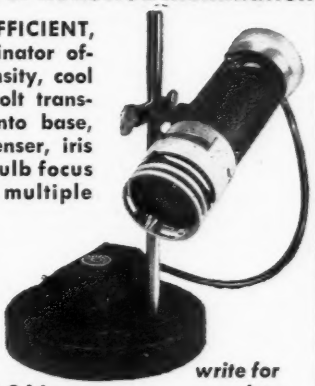
Write for Rate Card 26SC today—for more sales tomorrow!

THE E & G ALL-PURPOSE MICROSCOPE LAMP

Transmitted or Reflected Illumination

VERSATILE, EFFICIENT, this fine illuminator offers high intensity, cool operation, 6 volt transformer built into base, aspheric condenser, iris diaphragm, bulb focus 6" to infinity, multiple filter holder.

A completely adjustable, compact unit, moderately priced.



write for complete details - today

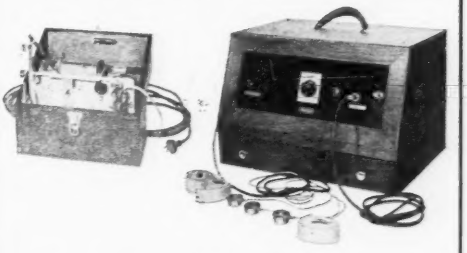
ERB & GRAY

SPECIALISTS SCIENTIFIC & OPTICAL INSTRUMENTS

Service to Science

854 SO. FIGUEROA ST. Los Angeles 17, Calif.

GUILLEMIN CARDIOTACHOMETER



Electrical potentials generated by heart beats converted into a permanent record. May be used on subjects during violent exercise.

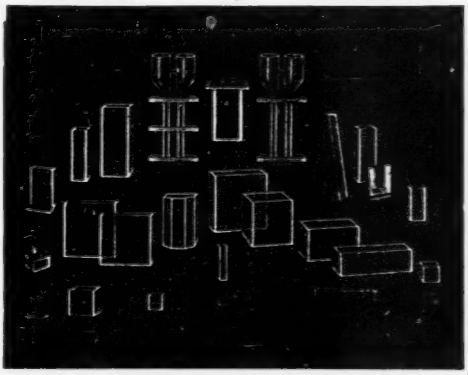
Write

PHIPPS & BIRD, Inc.

P. O. Box 2-V

Richmond 5, Va.

GLASS ABSORPTION CELLS made by KLETT



Makers of Complete Electrophoresus Apparatus

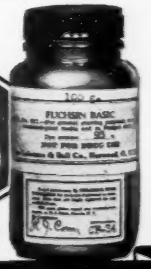
SCIENTIFIC APPARATUS

Klett-Summerson Photoelectric Colorimeters—Colorimeters — Nephelometers — Fluorimeters — Bio-Colorimeters — Comparators — Glass Standards—Klett Reagents.

Klett Manufacturing Co.

179 East 87 Street, New York, New York

C&B Biological Stains



During the past thirty years The Coleman & Bell Company has developed processes for the preparation and purification of several hundred dyes for use as biological stains.

These products are prepared in our laboratories on a semi-commercial scale. In connection with their manufacture and purification, we have developed a testing laboratory equipped for testing the purity of these products both chemically and biologically. Most of the common stains are offered with the certificate of the Biological Stain Commission.

C & B Products are distributed by Laboratory and Physician Supply Houses Throughout the World

Write for copy of catalog. THE COLEMAN & BELL CO., Manufacturing Chemists, Norwood, O., U.S.A.

COLEMAN & BELL

Personnel Placement

CHARGES and REQUIREMENTS for "PERSONNEL PLACEMENT" Ads

1. Rate: 15¢ per word, minimum charge $3.00 for each insertion. If desired, a "Box Number" will be supplied, so that replies can be directed to SCIENCE for immediate forwarding. Such service counts as 8 words (e.g., a 25-word ad, plus a "Box Number", equals 33 words). All ads will be set in regular, uniform style, without display; the first word, only, in bold face type.

For *display* ads, using type larger or of a different style than the uniform settings, enclosed with separate border rules, the rate is $16.00 per inch; no extra charge for "Box Numbers".

2. Advance Payment: All Personnel Placement ads, *classified* or *display*, must be accompanied by correct remittance, made payable to SCIENCE. Insertion can not be made until payment is received.

3. Closing Date: Advertisements must be received by SCIENCE, 1515 Mass. Ave., N.W., Washington 5, D. C., together with advance remittance, positively not later than 14 days preceding date of publication (Friday of every week).

POSITIONS WANTED

Anatomist: Ph.D.; experience in gross and microscopic anatomy; available for summer teaching. Box 170, SCIENCE. X

Biochemist: Ph.D. June 1950. Organic and bacteriology minors. Research on antibiotics. Desires industrial research or academic position with research. Location immaterial. Single, age 30. Jewish. Box 158, SCIENCE. 5/26

Biologist: M.S. plus. Wide biological and chemical background. Two years assisting experience. Desires teaching position. Box 168, SCIENCE. 5/26

Chemist: Ph.D. with physics minor. Experienced teacher desires teaching position in chemistry and/or physics. Box 171, SCIENCE. X

Microbiologist-Bacteriologist: Ph.D. interested in academic position at professor level, for teaching, pure and applied research. Extensive academic experience and industrial research on antibiotics. Box 159, SCIENCE. 5/26

Physiologist: Ph.D., June degree, Enzymecytochemistry, 3 years teaching experience, biology, physiology, desires teaching position with research opportunities or research exclusively. Box 174, SCIENCE. X

Research Assistant: M.S., Phi Beta Kappa, Sigma Xi, Publications, Experience, Training in Physiology, Biochemistry, Bacteriology. Box 172, SCIENCE. X

Zoologist: Ph.D.; Experienced teacher, presently engaged in industrial research. Desires teaching position with opportunity for research. Publications. Cytology, Genetics, Exology, Invertebrate Zoology. Box 173, SCIENCE. X

Parasitologist; will receive Ph.D. in August; twelve years' teaching experience; prefers teaching in college or university with opportunity for research; for further information, please write Burneice Larson, Medical Bureau, Palmolive Building, Chicago. X

Are YOU seeking a new position?

41 REPLIES received from ONE classified ad in SCIENCE . . . . YOUR ad here will get RESULTS !

AVOID DELAY . . . . *Cash in Advance payment*
MUST be enclosed with ALL classified ads.
(See "Charges and Requirements" above.)

Personnel Placement

POSITIONS OPEN

Positions Open:
(a) Ph.D. with agriculture and poultry husbandry training and background, to become associated with poultry department, agricultural college; duties consist of poultry processing and marketing involving work in field of food technology, economics of marketing and distribution; West. **(b) Research assistant;** department of pathology, university school of medicine; preferably physician or Ph.D. with sound background in biology or chemistry; research principally in cancer; around $6000. **(c) Biochemist;** Ph.D. or equivalency required; slight preference for young man; research assistantship; one of leading research institutions, Chicago area; around $4000. **(d) Chemist** to supervise general routine biochemical procedures in laboratories of large general hospital having teaching facilities; should be able to set up techniques for medical-legal toxicology and to advise on isotope program; Ph.D. or Sc.D.; $5,000–$6,000; New England. **(e) Bacteriologist;** food research department, Middle Western university. S5-4 Burneice Larson, Medical Bureau, Palmolive Building, Chicago. X

Science Editor: General science background in physical and biological sciences with writing and/or publishing experience. Challenging opportunity for younger man in dissemination of scientific knowledge at adult level and publishing. Salary varies with academic training and experience. Address Franklin J. Meine, Editor-in-Chief, American Peoples Encyclopedia, 153 N. Michigan Avenue, Chicago. 6/9

The Market Place

BOOKS

Send us your Lists of tf
SCIENTIFIC BOOKS AND PERIODICALS
which you have for sale.
Complete libraries; sets and runs; and single titles are wanted.
Also please send us your want lists.
STECHERT–HAFNER, INC., 31 East 10th Street, New York 3.

Your sets and files of scientific journals
are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. J. S. CANNER AND COMPANY, 909 Boyston Street, Boston 15, Massachusetts. tf

WANTED TO PURCHASE:
SCIENTIFIC PERIODICALS
Sets and runs, foreign and domestic
SCIENTIFIC BOOKS
Entire libraries and smaller collections
WALTER J. JOHNSON
125 East 23rd Street, New York 10, N. Y.

LANGUAGES

LINGUAPHONE MAKES LANGUAGES EASY
At home learn to speak Spanish, Portuguese, Italian, French, German, Russian, by quick easy Linguaphone Conversational Method. Save time, work, money. Send for free book today. LINGUAPHONE INSTITUTE, 84 Radio City, New York 20.

PROFESSIONAL SERVICES

• **Amino Acids**
• **Proteins**
• **Vitamins**
Microbiologic Assay
SHANKMAN LABORATORIES
2023 S. Santa Fe, L. A. 21, Calif.

TELL and SELL . . . **YOUR SALES STORY** to the more than 33,000 SCIENCE subscribers . . . a fertile market for your Scientific Books, Services, or Supplies.
. . . this same responsive audience, as evidenced by the increasing number of regular "satisfied" advertisers.
. . . PROOF that SCIENCE advertising *produces results!*
Write for Rate Card 26E today—for more sales tomorrow!

The Market Place

CHARGES and REQUIREMENTS for "MARKET PLACE" Ads

1. **Rate:** 20¢ per word for *classified* ads, minimum charge $5.00 for each insertion. Such ads are set in uniform style, without display; the first word, only, in bold face type. For *display* ads, using type larger or of a different style than the uniform classified settings, and entirely enclosed with separate rules, rates are as follows:

Single insertion	$16.00 per inch
7 times in 1 year	14.50 per inch
13 times in 1 year	13.00 per inch
26 times in 1 year	11.50 per inch
52 times in 1 year	10.00 per inch

2. **Payment:** For all *classified* ads, payment in advance is required, before insertion can be made. Such advance remittances should be made payable to SCIENCE, and forwarded with advertising "copy" instructions. For *display* advertisers, monthly invoices will be sent on a charge account basis—providing satisfactory credit is established.

3. **Closing Date:** Classified advertisements must be received by SCIENCE, 1515 Massachusetts Avenue, N.W., Washington 5, D. C., together with advance remittance, positively not later than 14 days preceding date of publication (Friday of every week).

For proof service on display ads complete "copy" instructions must reach the publication offices of SCIENCE, 1515 Massachusetts Avenue, N.W., Washington 5, D. C., not later than 4 weeks preceding date of publication.

PROFESSIONAL SERVICES

FOOD RESEARCH LABORATORIES, INC.
Founded 1922
Philip B. Hawk, Ph.D., President
Bernard L. Oser, Ph.D., Director
RESEARCH—ANALYSES—CONSULTATION
Biological, Nutritional, Toxicological Studies for the Food, Drug and Allied Industries
48–14 33rd Street, Long Island City 1, N. Y.
Write for descriptive brochure

SPECIAL GLASS APPARATUS
Our glass blowing department is available for special scientific and technical glass apparatus made to specifications and drawings. Inquiries invited. Estimates furnished.
E. MACHLETT & SON
218 East 23rd St. New York 10, N. Y.

CHEMICAL CONSULTATION, RESEARCH, DEVELOPMENT

THE PANRAY CORP.
Research Division
340 CANAL ST., NEW YORK 13
- Microanalysis (C, H, N, S, Etc.)
- Custom Organic Syntheses
- Chemotherapeutics
- Sponsored Research

SUPPLIES AND EQUIPMENT

LABORATORY ANIMALS
- Clean healthy well-fed animals
- Guaranteed suitable for your needs.

Reasonably priced—Dependable service

DOGS RATS RABBITS
CATS PIGEONS HAMSTERS
MICE POULTRY GUINEA PIGS
JOHN C. LANDIS • Hagerstown, Md.

All Amino Acids (natural, synthetic, unnatural), Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone PLaza 7-8171 for complete price list.
BIOS LABORATORIES, INC. 17 West 60th Street, New York 23, N. Y.

The Market Place

SUPPLIES AND EQUIPMENT

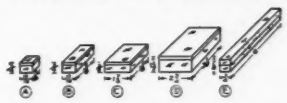
NEW 1950 CATALOG
ON
LABORATORY ANIMAL CAGES & ACCESSORY EQUIPMENT
NOW BEING PRINTED FOR JUNE MAILING—COPY SENT ON REQUEST
HOELTGE BROS., Inc.
1919 Gest St. Cincinnati 4, Ohio

HOLTZMAN RAT CO.
Specializing in the Production of
HIGH QUALITY WHITE RATS
for Laboratory Use.
R. 4, Madison 5, Wisconsin Phone 6-5573

STAINS
STARKMAN Biological Laboratory
- RARE
- COMMON

Price list on Request
461 Bloor St., W. • Toronto, Canada

TRANSPARENT BOXES
For Every Laboratory, Every Collector of Small Objects, Every Home Workshop!



Five Sizes Now Available
Write for New (June, 1949) Leaflet TR-S
R. P. CARGILLE
118 Liberty Street, New York 6, N. Y.

GLYCOCYAMINE—Hydroxyproline, L-Methionine
• AMINO ACIDS • BIOCHEMICALS
• PRE-MIXED MICROBIOLOGICAL ASSAY MEDIA
H. M. CHEMICAL COMPANY, LTD.
144 North Hayworth Avenue Los Angeles 36, California

ROGER* CAMERA TIMER
for time-lapse cinematography as used in many well-known institutions, here and abroad. for the study of slow processes.
MICRO-CINEMA EQUIPMENT.
ROLAB Photo-Science Laboratories
SANDY HOOK, CONNECTICUT
* *Formerly with Dr. Alexis Carrel.*

The SCIENTIFIC MONTHLY

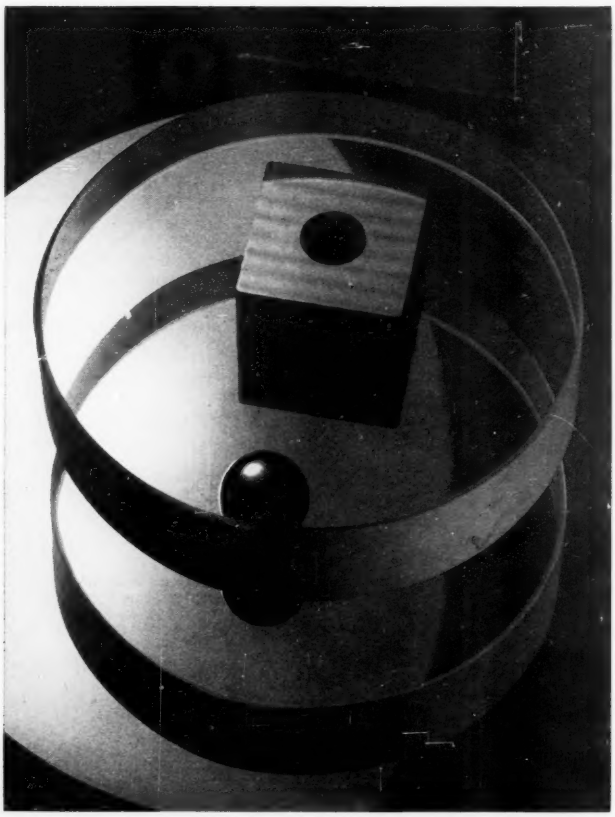
in cooperation with the

SMITHSONIAN INSTITUTION

announces the

4th ANNUAL INTERNATIONAL SALON

Photography in Science



Photograph from Third Salon
by Charles J. Salat
of Armour Research Foundation

ELIGIBILITY

Any scientist actively engaged in research (including photographic), teaching, private practice, or consulting work is eligible. All photographs must be taken for scientific purposes, and purely pictorial and hand-colored prints are not eligible.

DEADLINES

Entries will be received by The Editor, THE SCIENTIFIC MONTHLY, November 1 to 27, 1950. Prize winners will be notified on or before December 10, 1950.

AWARDS

First, second, and third awards and five honorable mentions will be given in each section. Suitable certificates will go to the winners.

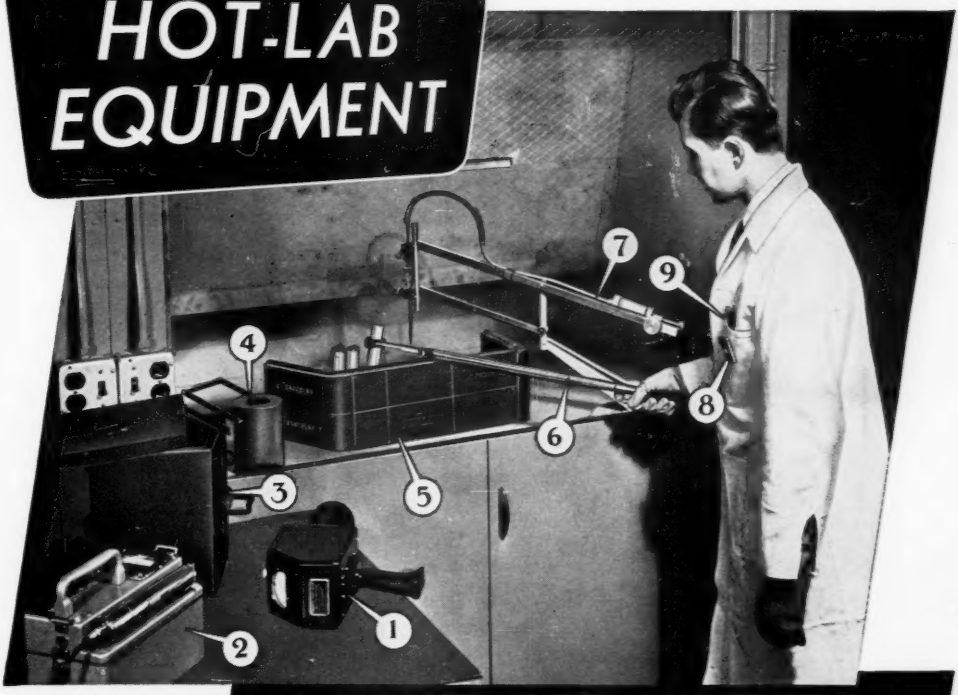
CONDITIONS

Prints must be mounted on 16 x 20 inch mounts, carrying technical and other information, and be shipped prepaid. No entry fee is required. A total of 8 entries (each one numbered), 4 in color and 4 in black and white, may be submitted. All entries will be returned after being shown in this country and abroad.

For complete information and entry blanks, write to

The Editor, THE SCIENTIFIC MONTHLY
1515 Massachusetts Ave., N.W.
Washington 5, D. C.

HOT-LAB EQUIPMENT



DESIGNED FOR PROTECTION

The selection of equipment and instruments for the protection of laboratory personnel who work with radioisotopes is a vital problem. A "hot lab" which uses substantial amounts of gamma emitters, for instance, should have the following:

(1) SU-1B Radiation Survey Meter
(2) SU-5 Beta Gamma Survey Meter
(3) E-12 2" Wall Lead Container
(4) E-15 1" Wall Cylindrical Lead Container
(5) E-23 Interlocking Lead Bricks
(6) E-17 Remote Handling Tongs
(7) E-18A Remote Pipetting Device
(8) Tracerlab Film Badge
(9) Pocket Dosage Meter

Different activity and energy levels of beta and gamma emitters require more or less equipment. We will gladly recommend the proper instrumentation for your particular problems. For further information on the selection of equipment for a radioactivity laboratory write for Bulletin S-25.

Tracerlab

Western Division
2295 San Pablo Ave., Berkeley 2, California
New York Office
General Motors Bldg., 1775 B'way, N. Y. 19
Midwest Office
LaSalle-Wacker Bldg., 221 N. LaSalle, Chicago

TRACERLAB INC., 130 HIGH STREET, BOSTON 10, MASS.

A WEALTH OF FEATURES
EVERY PATHOLOGIST NEEDS

SPENCER Pathologist's Microscopes

- **EXCLUSIVE "AUTOFOCUS" STOP** facilitates study of slides of similar thickness in rapid succession. It also reduces slide breakage and prevents racking objectives into the condenser.
- **CHOICE OF LOW POWER "FINDER" OBJECTIVES** helps in revealing tissue patterns and locating desired fields.
- **EXCLUSIVE "PINCH GRIP" BUILT-ON MECHANICAL STAGE** enables slides to be interchanged without disturbing stage settings.
- **COMPLETELY NEW 10X OBJECTIVE** is tapered for better oblique top lighting and provides a crisp, color-corrected image.
- **ATTACHED SUBSTAGE ILLUMINATOR,** optional equipment, furnishes convenient, permanently adjusted full-field illumination.
- **AMERICOTED OPTICS,** if desired, reduce internal reflections and provide better image contrast.

The new AO Spencer Pathologist's Microscopes include many features suggested by leading Pathologists. They permit rapid diagnosis, comfortable posture, convenient operation, reduced eye fatigue. The fine adjustment is closer to the stage and provides better finger clearance. Dual-knob coarse and substage focusing controls are always instantly adjustable to the degree of tension you desire. The stand is sturdier and more massive, yet much lighter in weight. Every feature has been *thoroughly* tested and proven capable of longer, harder wear than ever before.

You owe it to yourself. See your AO Distributor today and compare these outstanding new pathologist's Microscopes . . . or, for literature, write Dept. E4.

American Optical
COMPANY

INSTRUMENT DIVISION • BUFFALO 15, NEW YORK